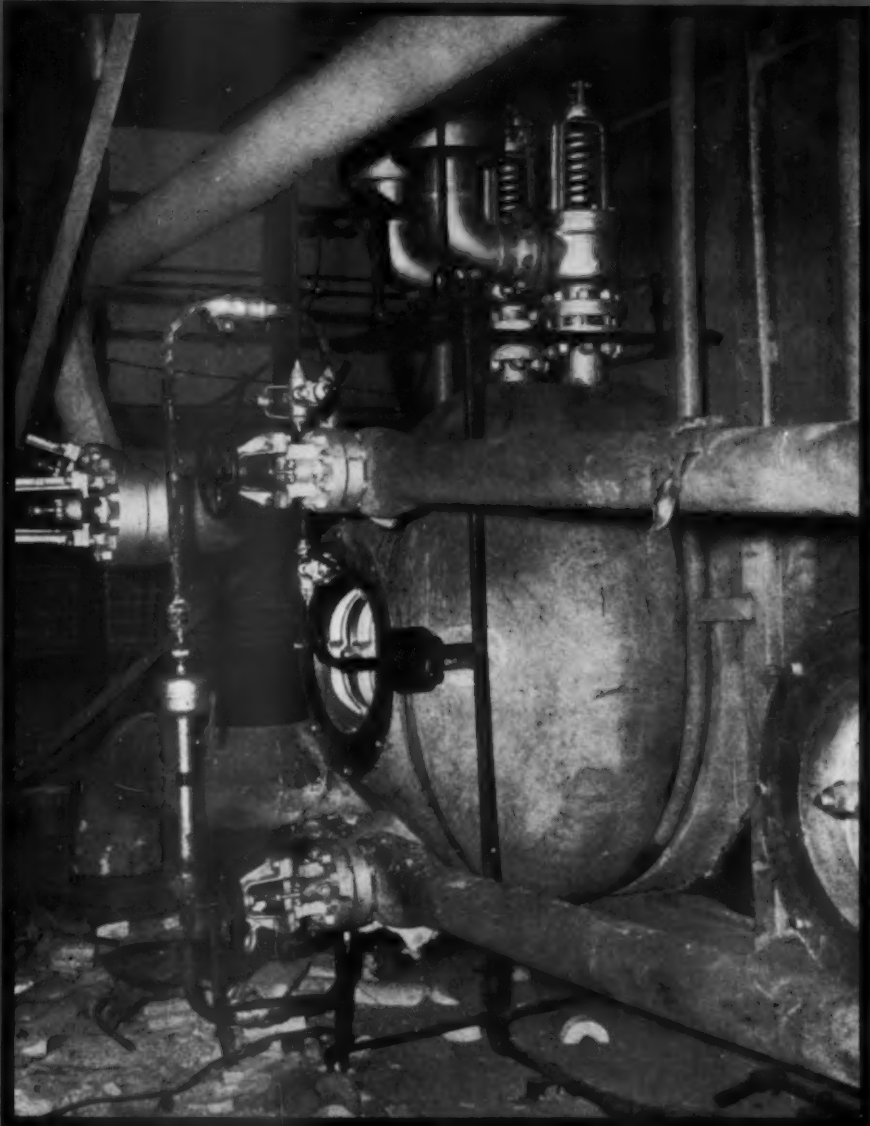
COMBUSTION

DEVOTED TO THE ADVANCEMENT OF STEAM PLANT DESIGN AND OPERATION

February, 1949



End view of main drum of Port Jefferson unit; see pages 34-41

Port Jefferson Power Station

Selection of Motors for Auxiliaries

Corrosion of Boiler Generating Tubes

COMBUSTION
DEVOTED TO THE ADVANCEMENT OF STEAM PLANT DESIGN AND OPERATION

VOLUME TWENTY NUMBER EIGHT

CONTENTS

FOR FEBRUARY 1949

FEATURE ARTICLES

EDITORIALS

DEPARTMENTS

Combustion is indexed regularly by Engineering Index, Inc.

GERALD S. CARRICK
General Representative

ALFRED D. BLAKE
Editor

THOMAS E. HANLEY
Circulation Manager

Published monthly by COMBUSTION PUBLISHING COMPANY, INC., 200 Madison Ave., New York 16
A SUBSIDIARY OF COMBUSTION ENGINEERING-SUPERHEATER, INC.

Frederic A. Schaff, President; Charles McDonough, Vice-President; H. H. Berry, Secretary and Treasurer.

COMBUSTION is sent gratis to engineers in the U. S. A. in charge of steam plants from 500 rated boiler horsepower up and to consulting engineers in this field. To others the subscription rate, including postage, is $3 in the United States, $3.50 in Canada and Latin America and $4 in other countries. Single copies: 30 cents.

Issued the middle of the month of publication.

Publication office, 200 Madison Ave., New York CCA Member of the Controlled Circulation Audit, Inc.

Printed in U. S. A.

EDITORIAL

Coal per Kilowatt-Hour

The average coal (or coal equivalent) per kilowatt-hour produced by electric utilities in the United States during 1948 is reported as 1.3 pounds which is about the same as that reported for several years past.

This may occasion some surprise in view of the attention being given to increased station efficiencies to offset higher fuel prices. However, it must be remembered that the number of post-war power stations of advanced design that have already gone into service is still too small to have an appreciable effect on the overall picture. Furthermore, with load demands increasing at an unprecedented rate it has been necessary to operate much of the older, less efficient equipment.

With completion of the ultra economical high-temperature reheat installations now under design and construction, and others to follow, it will be logical to expect a marked decrease in the average coal consumption per kilowatt-hour, especially when the increase in capacity outstrips the growth in demand.

Protection of Professional Employees

Pressure upon Congress for the repeal of existing labor legislation and substitution of the Administration Bill is of vital concern to all members of the engineering profession. Unless our legislators can be convinced that the special status of engineers and the justice of safeguarding their interests transcend political considerations, certain unfortunate rulings made under the 1935 Act are likely to be repeated and multiplied.

As has been pointed out many times, a fundamental defect of the Wagner Act, as it affected professional employees, was that it made no distinction between them and non-professional workers, despite inherent differences in training, abilities and viewpoints. It failed to recognize that conditions of employment of the two groups are not susceptible of measurement by a common standard, and that there is no yardstick by which technical skill and creative ability can be judged; in other words, regimentation is incompatible with the maintenance of professional standards. The bill now up for consideration differs little from the old Wagner Act.

On the other hand, the Taft-Hartley Act defines professional employees and safeguards their right to collective bargaining, if desired, either through their own representatives or by those of a larger overall bargaining unit, according to the wishes of the majority. It protects professional employees against arbitrary inclusion in large heterogeneous bargaining units in which their minority interests have no voice. Incorporation of these features was achieved through the concerted efforts of the nation's engineering societies.

Committees representing these societies have again been endeavoring to impress upon members of Congress the necessity of having these safeguards retained in whatever new labor legislation may be enacted; although it is obvious that Congress is under tremendous pressure from both organized labor and political quarters to return to the essential features of the Wagner Act. While these engineering societies represent a combined membership of perhaps 150,000, this number is greatly exceeded by the non-member engineers who are directly affected.

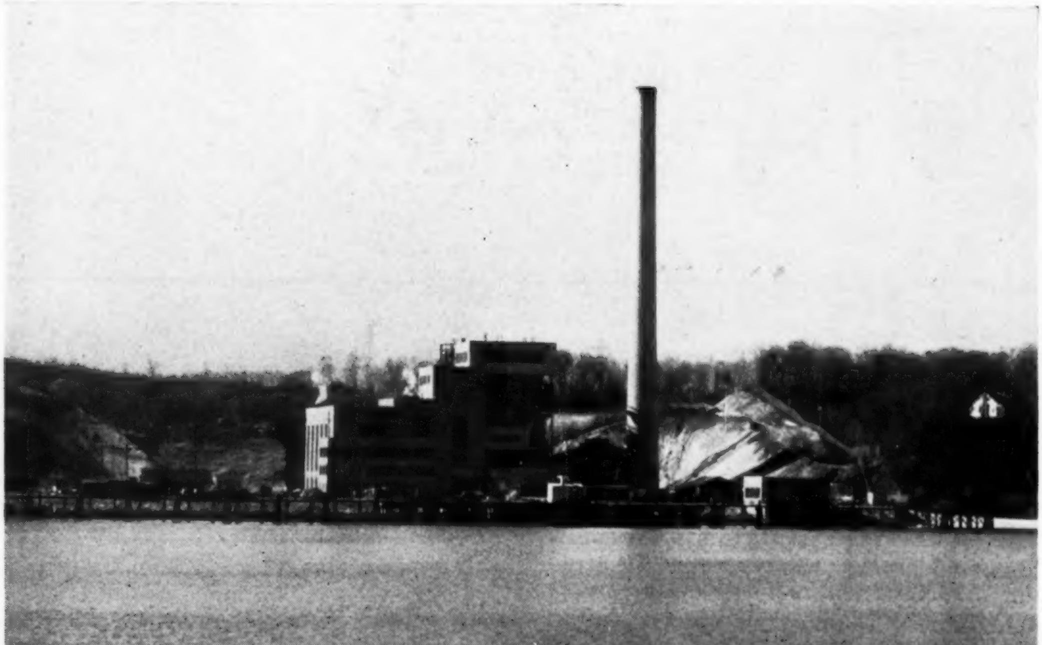
Heavy Scrap Needed

Once again the Government, through the Department of Commerce, is sponsoring a scrap drive in order to assist in improving the steel situation. Although the mills have been turning out a record production, this has been unable to keep pace with current demands; but since about half the ingredients in the process of making steel ingots and castings consists of scrap, an adequate supply would mean stepping up production considerably and to the limit of the recently extended facilities.

During the war some 123 million tons of steel and steel products were shipped overseas and only a very small fraction of this will ever be returned; although, through the efforts of a commission sent abroad last year, appreciable scrap shipments are now coming from Germany and a survey is now being made to determine what may be expected from Japan. At home scrapping of old vessels and military equipment has been temporarily halted and much old industrial equipment is still in use, all of which has contributed to a dearth of heavy scrap.

Unlike the drive during the war, when domestic and other light scrap was included, the present efforts are being directed at heavy scrap, such as is found around industrial plants, farms, and automobile wrecking yards.

Those able to contribute are urged to dispose of their scrap through regular commercial channels—that is, scrap dealers—and in this way it will reach the desired destination. Only through the cooperation of those in a position to aid can the present steel situation be improved.



View of station from harbor side

PORT JEFFERSON POWER STATION of the Long Island Lighting Co.

By W. J. BURNS

Steam Power Engineer, Long Island Lighting Company

The first 40,000-kw section of this semi-outdoor station went into service on December 12, 1948. Steam conditions are 1350 psig and 955 F at the superheater outlet. Designed for operation with pulverized coal as the primary fuel and oil as an alternate, the furnace is of the dry-bottom type, tangentially fired with automatic vertically adjustable burners. Both mechanical and electrostatic fly-ash precipitators are installed and air is the soot blowing medium. Five stages of feedwater heating are employed.

PRIOR to the supplementing of the Long Island Lighting Company System generating capacity by an interconnection with the Consolidated Edison Company of New York, and by the construction of the Port Jefferson Power Station, three steam plants, Glenwood, Northport and Far Rockaway, with a total net plant capability of 247,500 kw served nearly all of Long Island east of New York City, including the Rockaway area within the City limits.

Because additional firm generating capacity was needed to meet the rapid growth of population and industry in the area served by the System, the management of the Long Island Lighting Company decided that, based on load forecast studies, construction of the first section of an ultimate four-unit plant at Port Jefferson should be started before the end of 1946 in order to meet the expected peak load of 1948. Fulfillment of the initial phase of the overall program was realized when Unit No. 1 was synchronized to the System on December 12, 1948.

To provide the background required to reach the final decision regarding initiation of the Port Jefferson project, investigations were made of 35-mw, 50-mw and 60-mw unit sizes; and, to take into consideration the cost of fuel, 850-psig, 900-F and 1250-psig, 950-F pressure and temperature conditions in conventional condensing machines, were reviewed.

Only condensing units were given serious thought because topping of the turbine-generators in the existing plants would have resulted in relatively small additional capacity due to space limitations and to the sizes of the low-pressure units to be topped, and also because the existing boiler installations were made up of relatively modern, high-efficiency units. The detrimental effect during the construction period by removal of existing boiler capacity to be replaced with higher pressure units also made topping inadvisable.

The installation of additional capacity at the Far Rockaway Station was weighed against the erection of a new plant. The results of economic studies, however, indicated that steam conditions of 1250 psig and 950 F and an entirely new steam-electric station were justifiable.

In addition, the economic conclusions showed that the System could be best served by the installation of a generator of 40,000 kw capacity at 85 per cent power factor designed for 3-phase, 60-cycle, 13,800-volt operation, together with a turbine having a maximum rated capacity of 44,000 kw with steam at 1250 psig, 950 F and a 37,500-sq ft condenser.

A single-boiler, single-turbine plant was selected on the basis of proved reliability of other installations, including that at Far Rockaway. Other factors were lower first cost and reduction of maintenance resulting from having only one boiler, less piping, fewer valves, instruments and fans and a smaller building.

Pulverized coal was chosen as the primary fuel for economic reasons. Nevertheless, because of the importance to the System of the new capacity, the steam generator was designed also to carry full load when oil fired. This affords greater flexibility in the purchase of fuel and provides a standby fuel should the coal-handling system not be available or in the event of difficulty in maintaining a flow of wet coal to the pulverizers.

A semi-outdoor design of boiler was purchased on the basis of preliminary studies which indicated that substantial savings in building costs would result from adoption of such design. Accordingly, the steam generating unit has three sides exposed to the elements, with the exception of the lower totally enclosed section which houses the ash hopper, forced-draft fan and air compressors, and the burner and drum elevations which are enclosed with transite. A concrete slab covers the top of the boiler.

Site and Building Features

The need for large quantities of relatively cold circulating water and sufficient channel depth for receipt of fuel by barge made selection of a site difficult, for the availability of suitable areas large enough to accommodate future expansion of the proposed plant was limited.

Although the hilly terrain has been a detriment, by requiring the movement of thousands of cubic yards of earth, the site finally chosen adjacent to Port Jefferson Harbor, on the north shore of Long Island meets the condensing water and navigation requirements. It also affords an opportunity to improve transmission and distribution characteristics in the eastern end of the territory and to aid in stabilizing those facilities throughout the System.

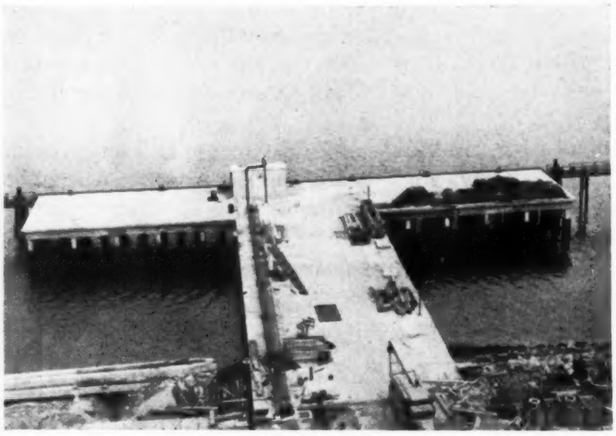
The main building comprises an office section which houses the various maintenance shops, warehouse, chemical laboratory, administrative offices, general offices and assembly rooms; a turbine room; electrical and auxiliary bay; a bunker bay; and a boiler room. The separate foundations of the boiler and turbine sec-

View of semi-outdoor boiler plant with adjacent steelwork for second section under construction

tions consist of concrete mats approximately five feet thick poured on reinforced concrete and timber piles, respectively.

The power station and the miscellaneous outlying buildings, which include a chlorinator house, a screen intake house, fuel oil pump house, precipitator substation and deep-well pump houses, conform to the same architectural treatment. Incorporated in the basic design are, in general, concrete foundations, structural steel framing, gray manganese spot face brick, limestone trim and coping, concrete roof slabs, and insulated, built-up roofing. Windows have been installed to provide light, architectural effect and natural ventilation, which has been supplemented as required by roof ventilators and fans.

Inasmuch as the nearest railroad terminal is approximately $1^1/_2$ miles distant and 200 ft higher in elevation it



T-shaped, reinforced-concrete wharf upon which fuel-handling facilities will be erected

was planned that all major equipment and fuel be delivered by water. Consequently, a T-shaped, reinforced concrete wharf, having a stem 50 ft wide and extending 130 ft from the bulkhead line to the 40 × 200-ft long head, has been erected to support the coal-handling facilities and to accommodate not only coal and oil barges but also ocean-going colliers.

Steam Generation

The initial installation consists of one 425,000-lb per hr Combustion Engineering three-drum steam generator designed to deliver steam at 1350 psig and 955 F at the superheater outlet. This is of the semi-outdoor type and features an insulated steel encased setting.

In each of the four corners of the tangentially fired furnace are four C-E Type TV coal burners and two Peabody steam-atomizing oil burners, all designed to permit vertical adjustment 30 deg above or below the neutral position. A light oil system and automatic electric pilot torches have been installed for lighting-off. To permit ready adjustment to suit load conditions the secondary air dampers have been arranged for remote manual operation from the main control room.

Light oil for ignition purposes is supplied to the bottom row of oil burners from a 10,000-gal storage tank by means of two Quimby Rotex pumps, each of 9 gpm capacity. Bunker C fuel oil, drawn from an 80,000-bbl tank located approximately 1100 ft from and 85 ft higher than the plant, is delivered to the burners through Griscom-Russell twin heaters by means of two DeLaval rotary pumps.

Pulverized coal is supplied by three No. 493 C-E Raymond bowl mills each driven by a 200-hp, 1200-rpm Westinghouse motor which also drives the exhauster. Each mill has a capacity of 21,300 lb per hr when pulverizing coal of 85 Hardgrove grindability and 8 per cent moisture. A feeder driven by a constant-speed motor through a Raymond variable-speed feed control unit serves each mill. The flow of coal from each individual section of the steel plate bunkers passes through a Stock Engineering valve to a Richardson scale and thence to the feeder. In addition to designing all of the piping between the bunker outlets and the mills to minimize the possibility of unscheduled stoppage of coal flow, each bunker outlet has been provided with a Syntron vibrator acting upon a hinged steel plate.

The 22 ft wide by 21 ft deep furnace, which has a gross volume of 31,000 cu ft, a heating surface of 9020 sq ft and a heat release of 17,900 Btu per cu ft per hr, is completely water cooled with plain tubes on the front and sides, plain and finned tubes on the rear and finned tubes on the roof. The 3-in. O.D. plain tubes are spaced $^1/_8$ in. apart and the rear wall tubes are bent out to form a screen of two rows ahead of the superheater. The furnace heating surface is supplemented by 6050 sq ft additional surface in the boiler section.

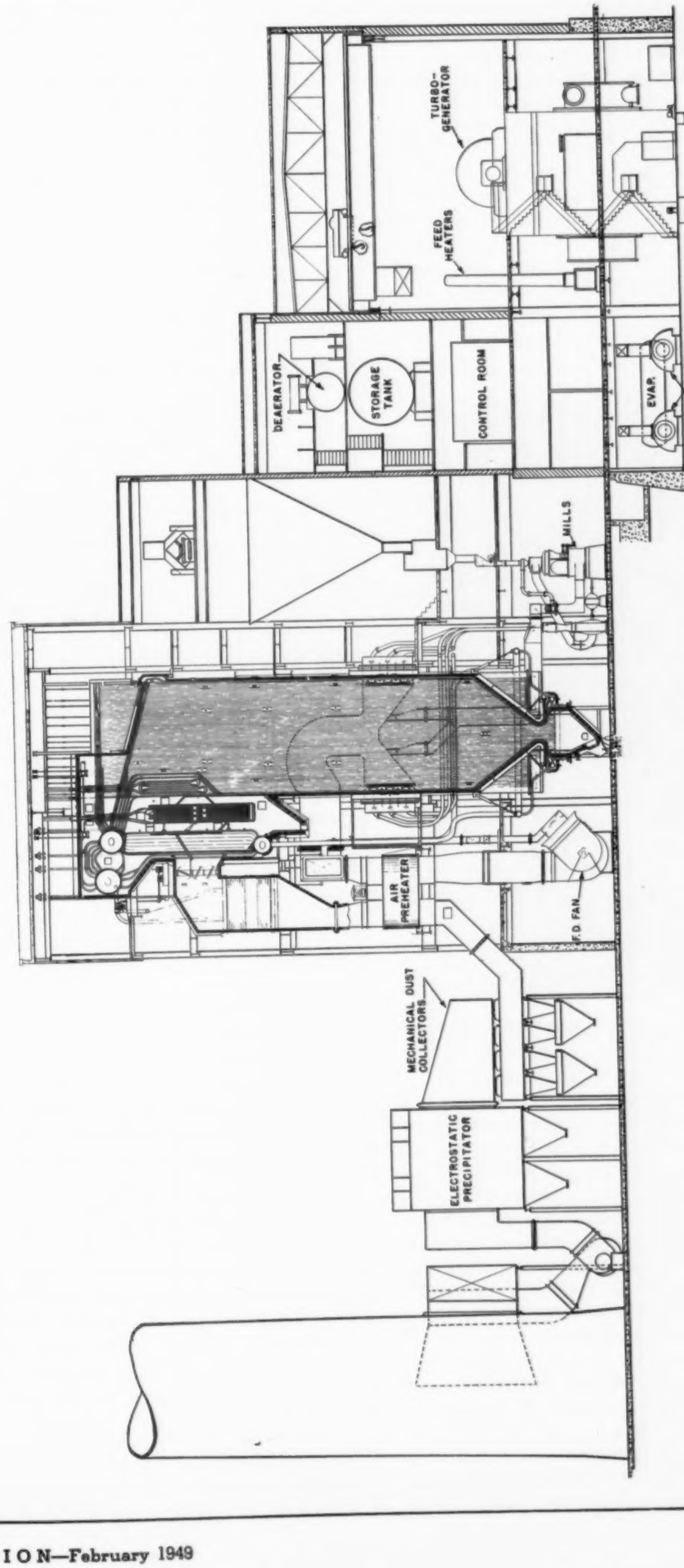
The 48-in. front drum affords primary separation of water and the 54-in. rear drum incorporates a bubble-type washer and a screen drier guaranteed to limit the solids carryover to 1 ppm when the total soluble solids in the concentrated boiler water and in the entering feedwater do not exceed 1000 ppm and 50 ppm, respectively.

Components of the steam generating system include an Elesco superheater, a C-E fin tube economizer, two Ljungstrom regenerative-type air preheaters, one American Blower forced-draft and two induced-draft fans, a Buell mechanical dust collector and a Research Corporation electrical precipitator.

The interbank superheater has a total heating surface of 15,043 sq ft divided into a high temperature second stage consisting of 81 two-loop elements and a low temperature first stage of 83 seven-loop split-type elements. Approximately half of the second-stage element surfaces are 0.300-in. minimum wall chrome molybdenum titanium stabilized seamless steel tubing, as per A.S.T.M. Specification A-213 Symbol T-16, and the remaining half consists of 0.250-in. minimum wall "DM" seamless steel tubing, per A.S.T.M. Specification A-213 Symbol T-11.

Temperature of the steam leaving the superheater is guaranteed to be held at 955 F, plus or minus 10 deg F, for the range of 300,000 to 425,000 lb per hr evaporation. A Leeds & Northrup electrically operated system is provided to maintain the steam temperature constant by automatically positioning the burner nozzles and the superheater bypass and shunt dampers. Although either the tilting burners or the dampers may be utilized as the primary element of temperature control it is planned to use the positioning burners to cover as wide a load range as possible and to employ the dampers only as a secondary means of control when required.

The continuous, separately set economizer has horizontal finned tubes arranged for counterflow, with the



Sectional elevation of Port Jefferson station

gas down and the water up. The unit, which is 16 tubes high by 36 tubes wide, has a total heating surface of 13,900 sq ft.

Each of the two vertical Ljungstrom regenerative air preheaters, designed for counterflow of air and flue gases, has an overall heating surface of 50,060 sq ft packed in the rotor in three layers 32 in., 18 in. and 12 in. deep, measured from the hot side. Each heater is equipped with an air-power operated, single-nozzle, oscillating-type soot blower which utilizes air at 200 psig as the cleaning medium. To prevent corrosion of the elements the air heaters are provided with a return duct to permit the recirculation of sufficient hot air to keep the plate temperature above the dewpoint when starting up the boiler, in banking, and when operating at very low ratings.

General view of turbine room with temporary wall shown in rear

Connected by duct work to the air heater outlets is a Buell multi-cyclone mechanical dust collector comprised of sixteen cyclones arranged in two groups of eight each. Immediately following the mechanical collector is a Cottrell electrical precipitator comprised of two units, each having two sections of 19 ducts. The precipitator outlets, in turn, are connected to the induced-draft fan inlets. This costly series installation of collectors was made to eliminate, in so far as possible, the fly-ash nuisance to the residential area surrounding the plant and at the same time to reduce maintenance on the induced-draft fans.

As shown in the cross-section, all fans are set at ground elevation. The forced-draft fan, which is located indoors, is a double inlet, two-thirds double width, Sirocco type, with water-cooled sleeve bearings and furnished by American Blower Corporation. Driven at 495 rpm by a 400-hp, 2300-volt Westinghouse motor the fan is capable of delivering 134,000 cfm of 100-F air at a total static head of 10.95 in. w.g. Inlet dampers of the louvre type are controlled automatically to regulate the air flow in accordance with the combustion requirements.

The two American Blower induced-draft fans, which are located outdoors, are of the double-inlet, two-thirds double width, Sirocco, water-cooled sleeve-bearing type with evasé outlets. Each unit, driven at 870 rpm by a 400-hp, 2300-volt General Electric splash-proof motor, is capable of handling 111,300 cfm of 300-F gas against a total static head of 15.1 in. w.g. Automatically operated louvre-type inlet dampers and hand-operated outlet louvre-type dampers are provided for each fan.

Flue gas from the induced-draft fans is discharged into a 13-ft 6-in. minimum inside diameter, 300-ft, fully lined radial brick stack. This stack, which has been designed to accommodate two 40,000-kw units, has a venturi orifice in the lining cap which is adjustable to provide 75 fps exit gas velocity first with one and later with two boilers.

Soot Blowers

A Vulcan automatic, sequentially air-operated and controlled compressed-air soot blower system serves the boiler. Four retractable units, each having a travel of approximately 11 ft, and utilizing 200 psig air at the nozzles, are arranged two on each side of the steam generator adjacent to the superheater sections. Six rotary blowers, employing 100 psig air at the nozzles, have been installed on the boiler and superheater sections and eight similar units have been mounted on the economizer in two rows of four each. No wall blowers have been installed, although boxes have been provided for eighteen wall blowers and two future rotary units.

Control of the soot-blowing system, including the integral soot blowers of the two air preheaters, is centralized on the boiler gage board, where sequential drum controllers have been installed to afford complete automatic operation of the blowing system on any prescribed schedule. Motion and position indicators are provided for the retractable units and an emergency button permits the ready withdrawal of any element.

Air for soot blowing is supplied by two Ingersoll-Rand three-stage, double-acting, water-cooled air compressors each having a capacity of 567 cfm of 500 psig air. Each compressor is driven by a 200-hp, 512-rpm, 2300-volt Electrical Machinery Mfg. Co. open-type synchronous motor. Air storage is provided by one 500-psi receiver having a volume of 750 cu ft and one 300-psi receiver having a volume of 100 cu ft.

The steam generator has been equipped with a United Conveyor pneumatic ash-handling system which has a capacity of 25 tons per hr of ash and fly ash in the dry state. The system is designed to empty the four hopper sections under the dry-bottom type furnace and the six rear pass hoppers when operated manually. In addition, the installation is arranged to serve the four hoppers under the cyclone dust collectors, the eight hoppers under the electrical precipitators and the outlet at the base of the chimney automatically and in sequence when controlled remotely from a panel which is located in the main control room.

Ash and fly ash are delivered through 8-in. Durite conveyor piping to a 300-ton vitrified tile storage bin ar-

ranged for periodic discharge of the waste material through two dustless unloaders into trucks for convenient disposal.

Coal Handling

Coal handling facilities have been ordered but will not be installed until the middle of 1949. Designed for receipt of fuel only by water the equipment will have a maximum capacity of 300 tons per hr and should fulfill all future plant expansion requirements.

A McKiernan-Terry Type R unloading tower, mounted on the dock, will deliver coal by means of a 48-in. belt feeder to an American Pulverizer ring roll crusher located within the enclosed portion of the coal tower. An inclined 36-in. conveyor belt will carry coal over a magnetic pulley to a horizontal 36-in. reversible belt extending over the bunkers to a turning tower in the plant yard. Another 36-in. belt conveyor will receive coal from the reversible unit at the junction tower and deliver it to the storage area tower receiving chute, which will be of a swivel design permitting storage of approximately 1800 tons in a kidney-shaped pile.

Movement of coal from the live storage pile to, and return of fuel from, the 66,000-ton reserve storage area will be performed by a Caterpillar Model D-8 tractor, bulldozer and Model 80 scraper. Coal will be reclaimed by utilizing an underground hopper, a 48-in. belt feeder and a 36-in. return-belt conveyor, which will discharge to the reversible conveyor over the bunkers. Filling of the bunker sections will be accomplished by means of a double-ended, self-propelled, reversible, traveling tripper having two sealed-type discharge spouts and necessary seal belts. All of the coal-handling equipment, with the exception of the unloading tower, will be furnished by Robins Engineers, Division of Hewitt-Robins Inc.

Every effort has been made to design the unloading and handling facilities to be as dust free and as architecturally pleasing as possible. To effect these results the tower will be modified structurally to present a neat appearance, the conveyor galleries will be enclosed with transite, the tripper will be of the sealed type and the bunkers will be kept under a slight vacuum during filling operations.

Instruments and Controls

All essential boiler, turbine, generator, pump, ash-handling, soot-blowing and electric-switching controls are centralized to best facilitate total plant operation and to permit the plant to perform its functions with a minimum of personnel. A single, well-lighted control room located on the main operating floor midway between the turbine and boiler sections, is air-conditioned to reduce dust infiltration and to insure comfortable working conditions.

A Hagan combustion-control system, fully automatic and air operated, has been installed to maintain constant boiler pressure regardless of the steam output by regulating either oil or pulverized coal fuel feed, coal-air ratio when applicable and forced and induced draft. A steam-flow measuring regulator governed by the flow across the superheater, a master sender connected to the superheater outlet header, an air-flow measuring recorder, connected across the gas side of the economizer, and a draft regulator connected to the steam generating unit, constitute the essential combustion-control elements.

Although a Bailey three-element control system has been installed, no feedwater regulating valve has been provided. Therefore, loading air pressure determined by drum water level, steam flow and air flow acts on the control drive attached to the scoop of the hydraulic coupling of each boiler feed pump to set the speed of the pump and thus regulate drum water level.

A full complement of operating instruments has been provided on the boiler and turbine gage boards, including Bailey draft gages, Crosby pressure gages, General Electric ammeters, miscellaneous Leeds & Northrup temperature and conductivity recorders, and a Reliance Eye-Hye drum level gage.

Piping and Valves

The 10-in. gate valve in the main steam line is of the Reading, Pratt & Cady welded bonnet design, with body and bonnet made of cast chrome-moly steel, in accordance with A.S.T.M. Specification A-217 Grade WC, modified to contain 0.80 to 1.10 per cent chromium. Seat and disk are faced with stellite.

High-pressure boiler-feed gate valves are of Reading, Pratt & Cady bolted bonnet design, with bodies and bonnets of cast carbon moly steel, in accordance with A.S.T.M. Specification A-217 Grade WC. The 4-in. Edward globe type, flanged bonnet regulating valve in the feedwater bypass line has the body and bonnet made of cast carbon steel, in accordance with A.S.T.M. Specification A-216 Grade WC. All of these valves incorporate stellite facing and are motor-operated to permit their operation to be governed remotely from the central control room.

The main steam line to the turbine-generator is 10 in., Schedule 160, seamless carbon-moly-chromium steel, per A.S.T.M. A-280-46T modified to chemical content of ASTM A-213 Grade T-12 (0.80–1.10 per cent chrome) and is all welded. Boiler feed discharge piping is 8 in., Schedule 160, seamless carbon steel, per ASTM A-106 Grade A, 0.30 per cent maximum carbon, and is all welded with the exception of flanges at the boiler feed pump outlets.

Feedwater Cycle

The regenerative cycle, as here employed (see heat-balance diagram), includes two high and two low pressure Struthers-Wells closed feedwater heaters and one Worthington deaerating feedwater heater. All of the closed feedwater heaters are of the U-tube type and are installed vertically with the heads down. The fifth- and eighth-stage high-pressure heaters, which are designed for 2000 psig on the water side and 400 psig and 150 psig on the steam sides, respectively, have $^5/_8$-in. O. D., No. 16 BWG, 70–30 cupro nickel tubes. The sixteenth- and nineteenth-stage low-pressure heaters have $^7/_8$-in. O. D. No. 18 BWG copper tubes and are designed for 150 psig and 125 psig on the water and steam sides, respectively.

Drips from the fifth- and eighth-stage heaters normally are cascaded to the thirteenth-stage heater whereas drips from the sixteenth- and nineteenth-stage heaters are collected and pumped back into the condensate system between the two heaters. Under light load conditions, however, the eighth-stage heater drains to the sixteenth-stage unit, which in turn has its drips returned to the condenser.

Condensate leaving the sixteenth-stage heater is deaerated in a direct-contact, horizontal tray-type thirteenth-stage heater. Designed to reduce the oxygen content of 450,000 lb per hr of water to 0.005 cc per liter or less, this unit incorporates a 7-ft diameter by $17^1/_2$ ft long heating section containing two sets of cast-iron trays. Two vent condensers are provided to discharge noncondensables automatically either to the atmosphere or to the main condenser depending upon extraction steam pressures at various turbine loads.

Directly connected to the deaerator is a 12-ft diameter by 30 ft long storage tank. This vessel, which supplies the boiler feed pumps, provides a nominal 23-min storage of condensate at full load.

Boiler Feed Pumps

Two Ingersoll-Rand barrel-type, 8-stage pumps, each having a capacity of 475,000 lb per hr of 278-F feedwater when operating at 3600 rpm against a total dynamic head of 1590 psi, are located approximately 47 ft below the bottom of the deaerated water storage tank. These pumps have outer casings of cast carbon steel, while the internal parts are, in general, of 4–6 per cent chrome, 0.50 per cent molybdenum alloy steel, which has been found in the course of lengthy research and available operating experience to be effective in preventing corrosion-erosion. Each pump is driven by a Westinghouse 1500-hp, 3600-rpm, 2300-volt motor through an American Blower hydraulic coupling and is equipped with a Republic bypass control system which maintains minimum flow through each pump at 100,000 lb per hr.

Evaporators

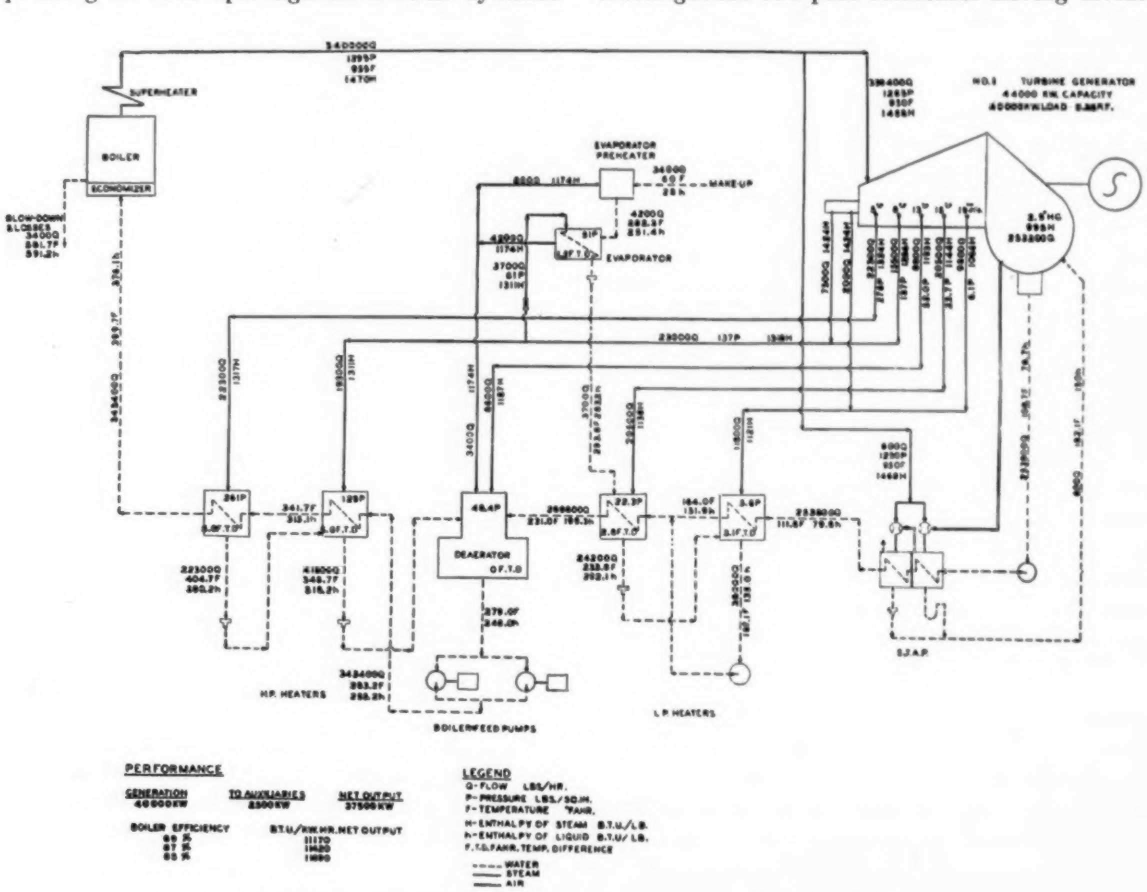
A Griscom-Russell evaporator equipped with an Elliott deaerating preheater has been installed to supply the feedwater system with makeup. This unit, which is supplied with steam extracted from the eighth stage of the turbine, is designed to have a net output of 15,000 lb hr of vapor having a total solids content of less than one-quarter grain when supplied with water from wells on the plant property.

A second evaporator provides 10,000 lb per hr of vapor at 125 psig for fuel oil heating and for general plant heating. The coils of this unit are supplied with steam from the main boiler drum through a $1^1/_2$-in. Swartwout valve which reduces 15,250 lb per hr from 1475 psig to 425 psig.

Circulating-Water System

The condensing equipment features a 37,500-sq ft Westinghouse two-pass condenser having divided water boxes made of nickel cast iron. The 5968 arsenical aluminum-brass tubes are 1 in. O. D., 18 BWG, 24 ft long and are rolled at both ends into $1^1/_2$-in. thick Muntz metal sheets. Tube expansion is accommodated by a steel diaphragm incorporated in the shell, which is of $^3/_4$-in. thick copper-bearing steel plate. A fabricated steel connecting piece is welded to the turbine exhaust and to the condenser, requiring that downward movement be compensated for by spring supports and rubber expansion joints in the circulating water piping.

Construction of the unit and arrangement of the valving permit cleaning of the tubes in one half of the con-



Station heat balance diagram for generation at 40,000 kw, $2^1/_2$ in. Hg back pressure

denser while the other half is in service. Individual sections are emptied of their contents rapidly and conveniently by means of a dewatering pump cross-connected between each water box and the circulating water discharge piping.

Supplementary auxiliary equipment, supplied by Westinghouse includes one twin-element, two-stage, steam-jet, air ejector and duplicate condensate and circulating water pumps.

The two 20,000-gpm, axial-flow circulating water pumps, driven at 585 rpm by constant-speed, vertical motors, are located in the intake house. Each pump is mounted in an individual intake basin and has on its suction side a coarse fixed screen and a Link-Belt traveling screen, which are afforded cathodic protection by use of a selenium rectifier and graphite anode ground bed. Salt water taken from Port Jefferson Harbor is discharged through 36-in. cast-iron pipe into a common 60-in. cast-iron main which carries cooling water to the condenser. A separate 60-in. line returns the heated water to the harbor. Recirculation is not expected to be a problem, for not only are the intake screen house and discharge seal well approximately 535 ft apart, but also the prevailing current in the harbor is from the intake to the discharge.

To reduce condenser maintenance by inhibiting or preventing marine growth in the circulating water system a Wallace & Tiernan chlorination process has been installed. Facilities to store and handle one-ton chlorine cylinders and to house the dispensing equipment have been incorporated in a chlorinator house, and rubber-lined pipe has been run between this building and the intake house to transport the chlorine solution to the suction of the circulating water pumps.

Electric Generating System

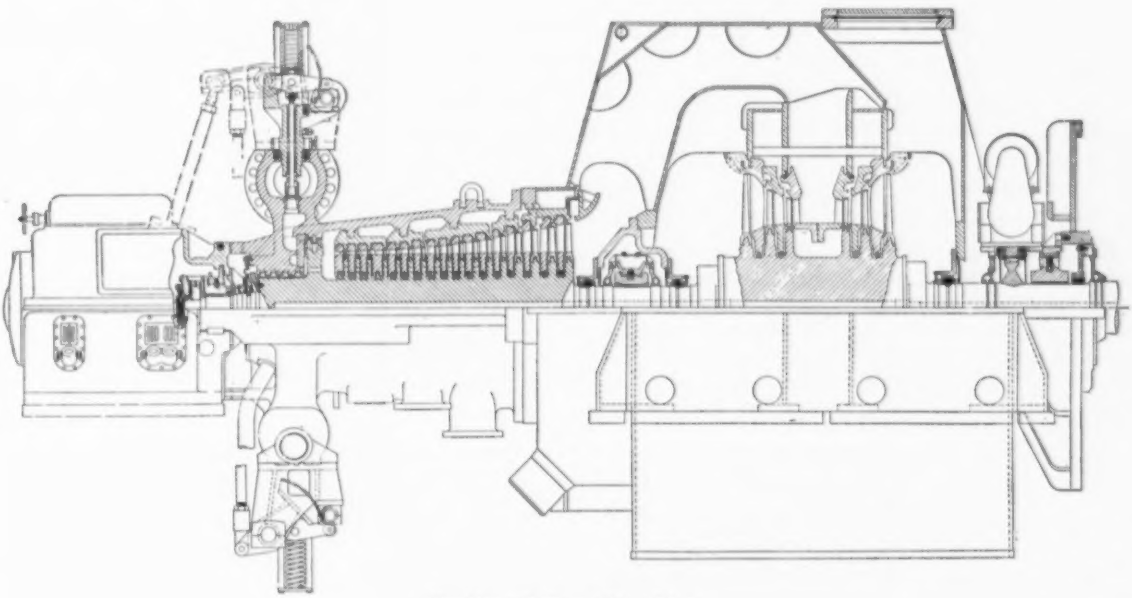
The General Electric turbine is a 40,000-kw, 3600 rpm, 21-stage, tandem-compound, double-flow condensing unit designed for throttle steam conditions of 1250 psig and 950 F.

Steam to the turbine passes through the emergency stop valve to the eight control valves assembled in an upper and lower steam chest and then through eighteen stages of the single-flow type and three stages of the double-flow type. The turbine wheels are machined integral with the turbine rotor, which is direct connected to the generator.

The generator of the unit is a 47,058-kva (at $^1/_2$ psig hydrogen), 85 per cent power factor, 3600-rpm, 3-phase 60-cycle, 13,800-volt hydrogen-cooled machine equipped with a main, direct-connected exciter, whose field is furnished by an amplidyne voltage regulator. The neutral of the generator winding is grounded by connecting the primary of a 150-kva G.E. distribution transformer between the generator neutral and ground, the secondary of the transformer being short-circuited through a resistor.

Power for auxiliaries is normally supplied directly from the generator leads through a Pennsylvania 5000-kva, 3-phase, 60-cycle, 13,800/2400-volt unit auxiliary transformer. Since all of the auxiliaries are motor operated a G.E. 2000-kva, 3-phase, 60-cycle, 23,380/2500-volt starting transformer has been provided for starting the station through the 23-kv operating bus when the main unit is not in operation. The generator leads are connected to a G.E. 45,000-kva, 3-phase, 60-cycle, 13,200/-69,000-volt main transformer which supplies the transmission system through the 69-kv and 23-kv switchyard, located approximately one-fourth mile from the power station. A 15,000-kva, 68,400/25,400-volt G.E. transformer connects the 69-kv and 23-kv systems at the switchyard.

Engineering and design and the construction supervision of the first 40,000-kv installation have been carried on by Ebasco Services, Inc., New York, under the direction of the Long Island Lighting Company's Messrs. E. W. Doebler, Vice President and General Operating Manager, and S. E. Bowler, Electric Operating and Engineering Manager.



Sectional view of turbine

Selection of Motors for Steam Station Auxiliaries

A discussion of motor drives for forced- and induced-draft fans, boiler-feed pumps, condensate and circulating pumps, and pulverizers, together with a comparison of the characteristics of induction and synchronous motors for such applications.

By G. L. OSCARSON
Chief Application Engineer
Electric Machinery Mfg. Co.

CONTINUED operation of power-plant auxiliaries in steam stations is as vital to uninterrupted service as that of the boilers or main generating units themselves. Hence the selection of motor drives for these auxiliaries involves careful consideration of such factors as type, torques and control to insure that operation is uninterrupted. Total connected load of such motor-driven auxiliaries will range from 5 to 20 per cent of the total prime mover rating, the average being about 10 per cent.

The forced- and induced-draft fans, boiler-feed pumps, condensate and circulating pumps, and coal pulverizers constitute virtually all of this load. Connected horsepower values, over a wide range of station ratings, comprising several plants is as follows:

Application	Average auxiliary motor horsepower in per cent of station rated capacity	Horsepower and speed range
Draft fans	1.5	50 hp at 1800 rpm to 1250 hp at 600 rpm
Feed pumps	2.9	125 hp at 3600 rpm to 1750 hp at 1800 rpm
Condensate and circulating pumps	3.9	15 hp at 1200 rpm to 700 hp at 400 rpm
Coal pulverizers	1.7	50 hp at 1200 rpm to 300 hp at 360 rpm

Standby or operating turbines for auxiliaries will average about 5 per cent of the station rating. Operating horsepower of these turbines is usually limited to such an amount that the exhaust can be utilized for feed-water heating.

In nearly all cases single-speed alternating-current motors are used to operate the power-station auxiliaries. More rarely single-frame two-speed motors or two single-speed motors coupled to the same shaft are used. Where speed variation, particularly of boiler-draft fans and boiler-feed pumps, is desired, magnetic or hydraulic slip couplings are commonly used. Direct-current motors are now rarely used to operate these auxiliaries.

Load Characteristics

DRAFT FANS

A survey of plant auxiliaries for 73 steam turbine-generator units being installed in 1946 and 1947 shows 19 induced-draft fans driven through slip couplings and 54 induced-draft fans driven by single- or two-speed motors and using damper or inlet vane controls.

Of the forced-draft fans for these units 10 were driven through slip couplings and 63 were constant speed.

Magnetic drives provide a precision speed control for such fans. These drives work ideally with synchronous motors as they can instantly unload the motor in case it drops out of step and thus permit it to resynchronize unloaded. The speed of response and accuracy of the

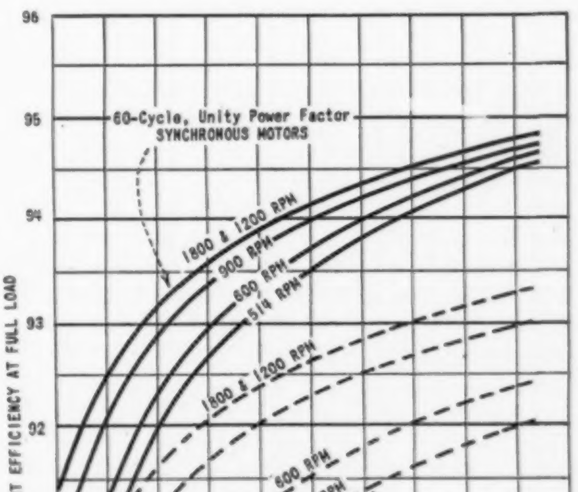


Fig. 1—Comparison of efficiencies of high-speed unity power-factor synchronous motors with induction motors. Efficiencies of 0.8 power factor-synchronous motors are approximately 1 per cent lower than those shown for 200 hp and under, and 1½ per cent above 200 hp.

magnetic drive control has caused combustion control manufacturers to speak favorably of these units for use in conjunction with their control devices.

Boiler-Feed Pumps

Variable-speed drives are rarely used on boiler-feed pumps which usually run at 3600 rpm, as mechanical problems are involved in designing and building 3600-rpm variable-speed drives. However, a few installations have been made of slip couplings on boiler-feed pumps. In general the feedwater flow is controlled by throttling the pump discharge or by controlling the speed of a small booster pump.

Condensate and Circulating Pumps

Condensate and circulating pumps are smaller and operate at lower speeds than do the boiler-feed pumps. Variable output is required and installations utilizing slip couplings have been made.

Coal Pulverizers

Pulverizer motors run at constant speed whether operating the mill alone or in conjunction with the primary air fan. The starting torque, in per cent of full load torque, must be high, particularly if the primary air fan is separately driven. Squirrel-cage motors are commonly used. However, because of the low speeds frequently used for pulverizer drive, synchronous motors may be utilized to advantage for reasons discussed later.

Motor Characteristics

Motors for use with power-plant auxiliaries should be of drip-proof or splash-proof construction. High building construction costs are causing a trend toward outdoor installations of many auxiliaries, and splash-proof enclosures are a minimum requirement for motors installed outdoors. Sleeve-type bearings seem to be preferred by central station operators. Flexible couplings, particularly on boiler-feed pumps, must be arranged so that no end thrust is transmitted to the motor shaft.

Torque requirements for most power plant auxiliaries are moderate and standard torques will usually suffice. One exception is the motor for operating the coal pulverizer. Starting torques of 150 per cent of full load torque may be required for this application.

High temperatures, and frequently damp conditions, prevail in many central stations. Therefore, Class B insulation should be given full consideration for locations where high temperatures exist. Moisture-resisting insulation is desirable. Coils should be dipped in moisture-resistant varnish and baked to provide adequate protection.

In view of the large horsepower ratings, and particularly where low speeds are involved, synchronous motors should be given full consideration. Synchronous motors operate at unity or leading power factor and provide a desirable magnetizing kva component to the system. Induction motors require that the system supply them with a magnetizing kva component. Moreover, synchronous motors operate at a higher efficiency than do induction motors. This is particularly true of low motor speed (below 500 rpm), where induction motors inherently have low power factor and low efficiency. Where large units operating continuously are involved the power saving per year may be considerable with high efficiency motors. Synchronous motors have much larger air gaps than do induction motors of similar ratings. In large sizes (500 hp and larger) they generally cost less than induction motors, particularly in medium and low speeds. Fig. 1 illustrates efficiency margins the synchronous motors have over induction motors in the medium-speed range.

However, an exception is found in 3600-rpm motors, at which rotative speed the power factor and efficiency of induction motors are high; and the cost is much less than that of 3600-rpm synchronous motors. As a result 3600-rpm synchronous motors are rarely justified.

In many cases synchronous motors operating at 0.8 power factor should be used. At full load they then supply a magnetizing kva component equal to approximately 60 per cent of the motor rating. This is increased at partial loads. Induction motors always have a lagging kva component which is relatively larger on low-speed motors. This component does not decrease proportionally with decrease in load and the power factor at partial loads is quite low. Fig. 2 shows the relationship between load and leading reactive kva component available in synchronous motors.

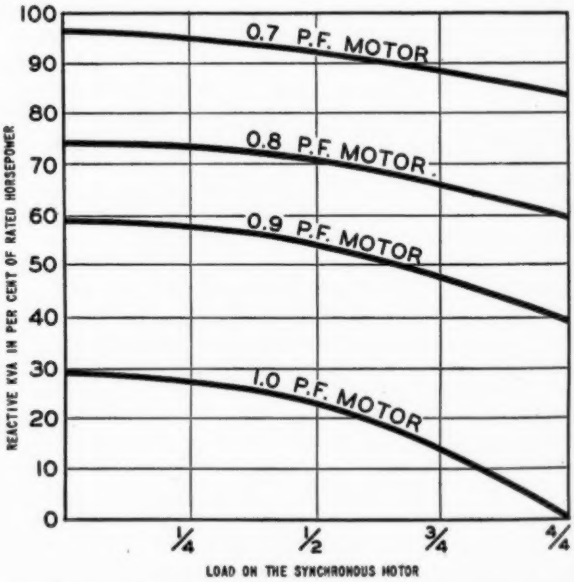


Fig. 2—Curves showing leading reactive kva, in per cent of the rated horsepower, that synchronous motors of various power-factor ratings supply at different partial loads

Leading power factor synchronous motors can readily be built with pull-out torques up to 250 per cent of full load torque. They will then carry full load continuously, as far as pull-out torque is concerned at 40 per cent line voltage, providing full excitation is maintained. The pull-out torque of synchronous motors at full excitation varies directly with line voltage. Actually, for a transient period of up to one second the pull-out torque may equal 350 per cent. The stalling torque of induction motors is about 200 per cent and it varies as the square of the applied voltage. At approximately 70 per cent

voltage the motor may stall if full load torque is required by the driven load.

Power Supply and Control Characteristics

For ratings up to and including 100 hp 440-volt motors should preferably be used, above which 2300 volts is to be preferred. In the majority of cases the transformer supplying motors driving power-plant auxiliaries are connected directly to the station bus. They are thus subject to system disturbances such as result from grounds, short-circuits, lightning, switching surges, etc. These disturbances frequently result in partial or total voltage failure for varying periods of time. Hence motor and control characteristics must be such that they provide the means of operating as uninterruptedly through such disturbances as is possible. In the case of induction motors such protection may be secured by use of time-delay undervoltage releases.

Synchronous motor control should have the line contactor and field contactor held in by direct current from the excitation source, or latched mechanically so they do not drop out on voltage dips. The control must be provided with some form of relay to remove the excitation in case the motor actually drops out of step. In addition, the synchronous motor must have sufficient pull-in torque to resynchronize as soon as conditions are restored to normal. Automatic means providing partial unloading are readily supplied where magnetic drives are used. Such unloading facilitates resynchronizing subsequent to voltage dips.

The characteristics of the load, motor and control must be coordinated in all respects to provide protection for the motor and still insure that every effort is made to insure continuity of operation.

Summary

The following tabulation will summarize advantages and disadvantages of squirrel-cage and synchronous motors as applied to power-plant auxiliary drives. The advantages of utmost simplicity of the squirrel-cage motor must be weighed against the greater complexity, but superior operating characteristics, of the synchronous motors.

Element	Squirrel-cage Motor	Synchronous Motor
Stator	Virtually identical	Virtually identical
Rotor	Simple squirrel-cage winding on core	Low voltage—salient pole winding, plus amortisseur winding for starting
Collector rings	None	Two
Exciter	None	Yes—generally 125 volt
Air gap	Small	3 to 5 times squirrel-cage-motor air gap
Starting torque[a]	Varies as V^2	Varies as V^2
Pull-in torque[b]	Not a factor	Varies as V^2
Stalling torque	About 200 per cent Varies as V^2	About 250 per cent on 0.8 p.-f. motors. Varies directly with voltage
Efficiency	Lower than synchronous efficiency except at 3600 rpm	Relatively high, particularly in medium and low speeds
Power factor	Always lagging—low at part loads and low speeds	Preferably 0.8 leading at full load. Additional correction at part loads
Primary controls	Usually across-the-line	Usually across-the-line
Field control	None	Yes—should be of field removal type if motor drops out of step
Comparative overall cost	Low—except at low speeds	Probably low in low speeds and large ratings

[a] Starting torques are readily obtainable on either type of motor.
[b] High pull-in torque for high inertial loads is harder to obtain on synchronous motors. This is immaterial if slip couplings are used.

Facts and Figures

Approximately half of the turbine capacity now building for utility plants will employ steam pressures under 1000 psi.

•

Surface or strip mining has shown a marked increase from a yearly average of 30,331,000 tons for the 1935–1939 period to 135,000,000 tons in 1947 according to —Bituminous Coal Institute.

•

A 1750-hp variable pitch pump drive to maintain constant motor speed independent of pump loading has been designed for variable speed pumping at a Naval ordnance research laboratory.

•

Sweden is now building a 600-mile transmission line that will employ 380,000 volts, the highest commercial voltage yet employed.

•

Carbon dioxide and water vapor are both capable of absorbing heat by radiation and of giving out non-luminous radiation.

•

The greater immunity of cast iron from acid corrosion, as compared with steel, is said to be due to a protective film resulting from iron silicide in the cast iron.

•

A recent compilation of 27 gas turbines in service or under construction for stationary power or locomotive service accounts for approximately 200,000 kw capacity. This is exclusive of those used with the Houdry process in oil refineries. The largest of these units, to go in service abroad this year, will be rated at 27,000 kw.

•

Fuel consumed in a nuclear reactor consists of fissionable material which produces heat for conversion into power. If the so-called breeding process works, as scientists have reason to believe, the reactor will more than replenish the fuel consumed in operation. In addition to producing heat, a breeder-type reactor would convert nonfissionable uranium-238 into new fissionable matter.

•

The U. S. Bureau of Mines reports that fewer American miners lost their lives in 1948, in proportion to the tons of coal produced, than in any previous years since such records were begun in 1910. The fatality rate per million tons was 1.46 for bituminous coal and 2.54 for anthracite, or a combined death rate of 1.56 per million tons.

•

Means of testing resistance of various metals to pitting or erosion due to cavitation have been devised wherein a material sample is vibrated through a distance of three to four thousandths of an inch for a two-hour period at a rate of 6500 cycles per second. These tests are estimated to be the equivalent of several years usage in the type of apparatus in which cavitation occurs.

STEPS IN ERECTION OF A ST

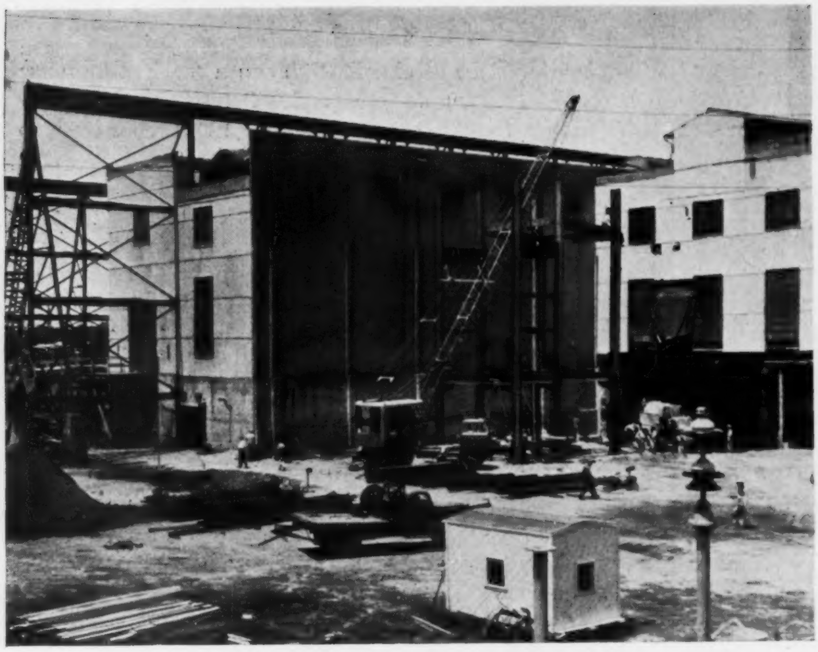


Fig. 1—The steelwork goes up

These construction photographs were taken of an extension to the boiler plant of the Waco Station of the Texas Power & Light Company. The unit, which was completed in December 1948, is of the C. E. two-drum type, oil and gas fired, and is rated at 150,000 lb per hr, of 650-psi, 835-F steam

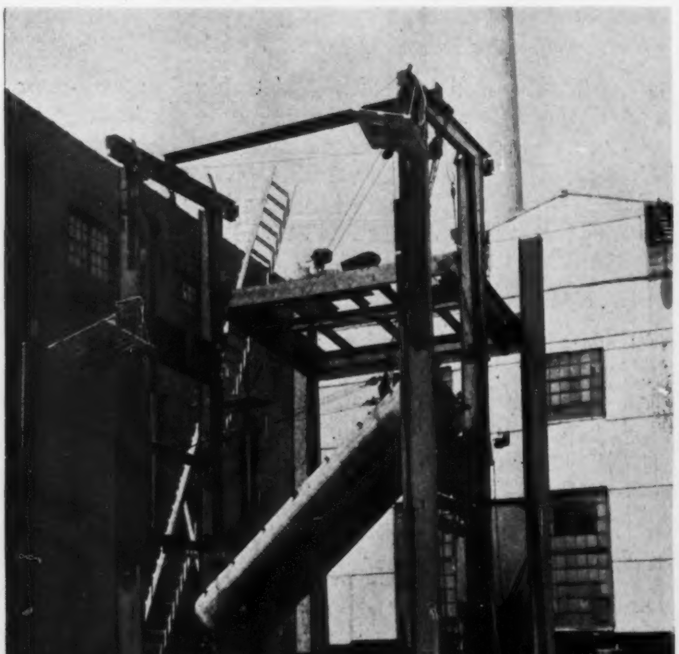


Fig. 2—Hoisting the upper drum

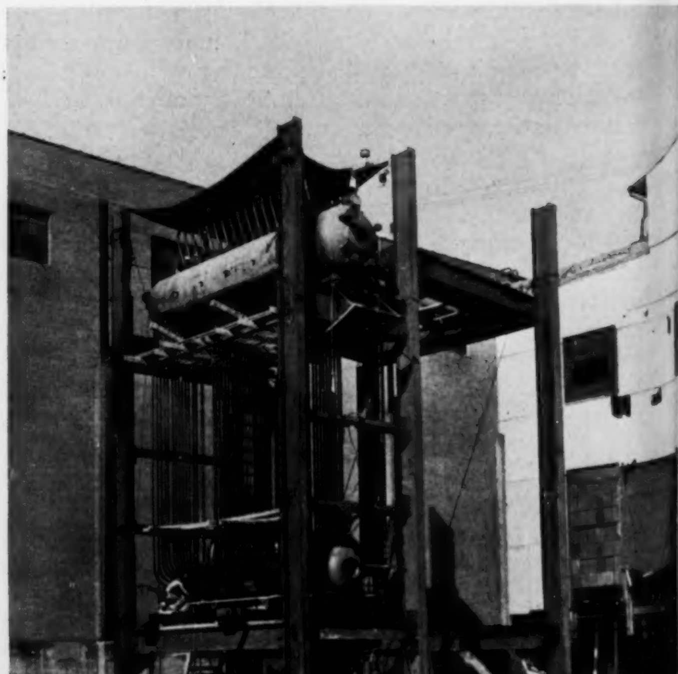


Fig. 3—Drums and part of tube bank in place

STEAM GENERATING UNIT

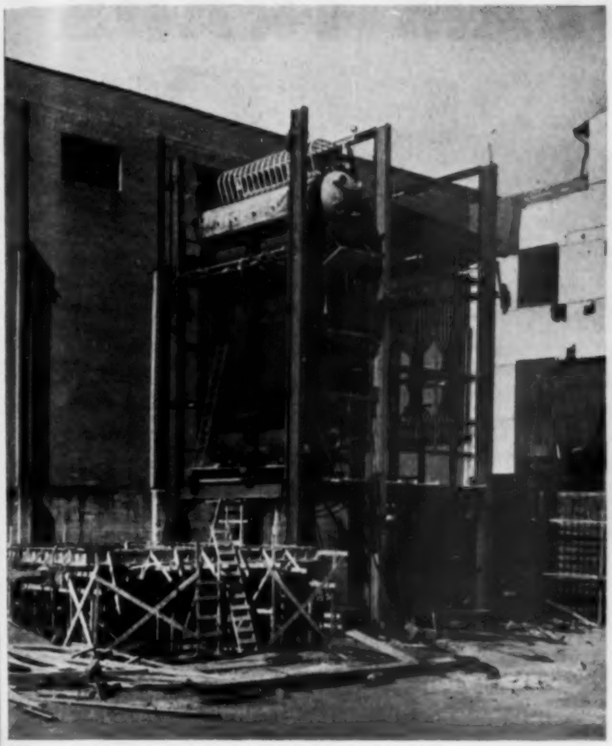


Fig. 4—Front wall has been added

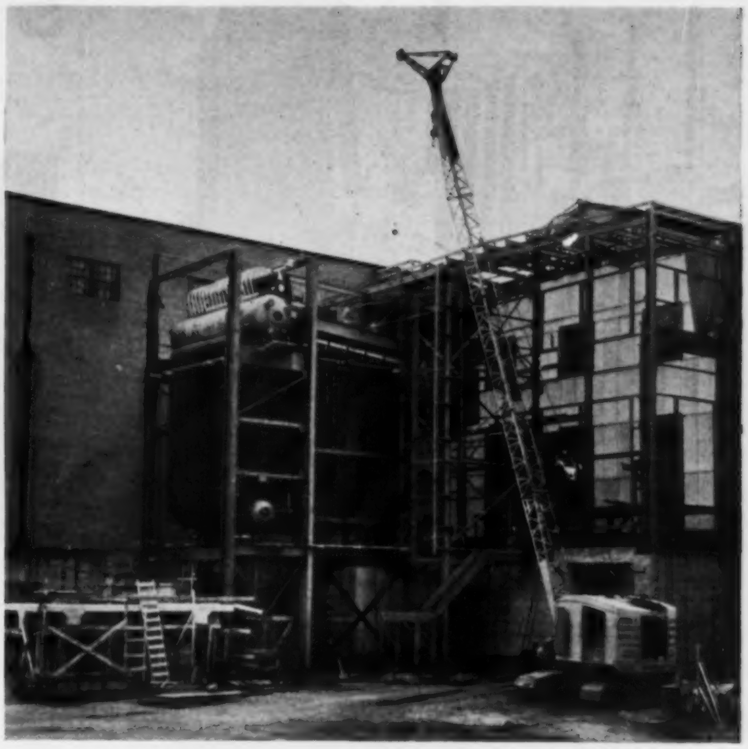


Fig. 5—Side walls and headers completed

Fig. 6—Approaching completion with casing and ducts erected

Corrosion of Boiler Generating Tubes

By R. L. REES and E. A. HOWES

British Electricity Authority

In a paper delivered before the A.S.M.E. Annual Meeting last December the authors discussed corrosion problems encountered in two British electric generating stations. Analysis of the corrosion products disclosed considerable quantities of copper, while makeup water included an increased ammonia content. Steps taken to correct these conditions are noted.

THE type of corrosion described has been experienced for the last few years in two generating stations of the London Power Company Ltd., namely, Deptford West and Battersea. The former operates at a pressure of 375 psi while the latter operates at 625 psi.

Deptford West

The boilers in which corrosion occurred are of the bent-tube, multidrum type with water walls. Corrosion was first noticed in 1940 and necessitated replacement of many tubes. The location was the same in nearly every case, being confined almost entirely to the expanded ends of the tubes. The corrosion product seemed identical with that reported in the boilers at Springdale.[1] In some instances the barnacles were $1^1/_2$ in. in diameter, and in every case examined they were laminated, and often copper was found between the laminations.

Corrosion was partially arrested in 1941, but in 1943 trouble occurred again and was continuing when the writers investigated the matter in February 1945. At this time corrosion was still confined to the expanded tube ends in the top of the central row of generating tubes. Affected tubes were picked at random and cut in half to determine the location of other possible corrosion sites. In general, the remaining tubes were in excellent condition, although a few very small barnacles were found in isolated places.

An effort was made to determine any significant feature concerning these embryo barnacles, but beyond the fact that the few found were on the furnace side, and therefore subjected to greatest heat transference, no significant fact emerged. Severe corrosion was confined to the expanded end and in one case the corrosion pit had penetrated the tube and had affected the drum metal.

Prior to 1940 no water treatment had been given these boilers and the quality of condensate and of evaporated makeup were excellent. In September 1940 boiler-water conditioning was introduced, sodium phosphates being used essentially for controlling alkalinity which was maintained around 40 ppm $CaCO_3$ above pH 8. Phosphate concentration was maintained around 8 ppm PO_4 and the sulfate/alkalinity ratio was approximately 3.5. Sodium sulfite was not injected into the drums of steaming boilers except before a banking period or when the boiler was to be taken off range. The oxygen content of the feedwater during operation was below 0.02 ml./liter O_2, but it was subsequently proved that the content of the topping-up water during banked periods was frequently of the order of 0.1 ml./liter. The rate of attack was found to be extremely rapid and a large number of tubes were corroded to such an extent that replacement was necessary in six to nine months.

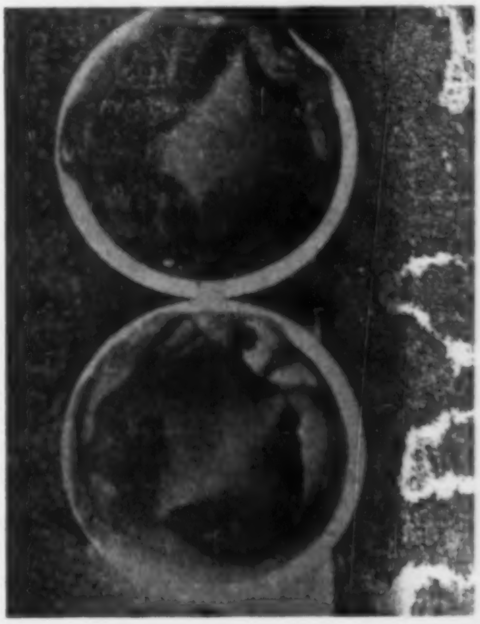


Fig. 1—Cross-section of tube removed from Boiler No. 17, Deptford West

Analysis of the sludge in the drum showed a high metallic copper content and the material surrounding the magnetic barnacle was identified by X-ray examination as metallic copper without trace of cuprous oxide.

The boiler waters in these units were analyzed at least three times a week and inspection of the records gave no indication of adverse water quality.

Occurrence of corrosion in this area led to the inference that bad circulation might be a contributing factor and it was possible that the laminated corrosion product was the result of tube starvation followed by flooding from the drum.

[1] "Corrosion and Embrittlement of Boiler Metal at 1350 Pounds Operating Pressure," by L. E. Hankison and M. D. Baker, Trans. A.S.M.E., Vol. 69, No. 5 1947, pp. 479–486.

Battersea

The boiler house at Battersea is composed of two sections. The A section boilers operate at 625 psi, 875 F and the B section, as yet incomplete, operates at 1420 psi, 960 F. Both operate on the closed feed system, makeup being produced by evaporation of city water.

No corrosion had been observed until June 1945 when a bottom row bottom bank generator tube failed in an A station boiler. This tube was removed and sectioned and it was found that almost the entire length was corroded along the part subjected to intense radiation. For a distance of approximately $2^1/_2$ ft from each end the tube was in very good condition and investigation showed that these areas were not subjected to the full intensity of the fuel-bed radiation. The actual seat of the failure was approximately 11 ft from the downcomer and was therefore near the center of the $18^1/_2$-ft-length of tube. Six inches from the actual failure was another potential burst as the metal had deformed to form a pustule about $^3/_8$ in. high and $^3/_4$ in. in diameter. The failure was due initially to corrosion followed by local overheating and plastic deformation of the metal caused by the low thermal conductivity of laminated magnetic oxide deposit found in the tubes.

A little later tube failures showed the corrosion to be widespread and every A station boiler was affected. In some the corrosion had affected almost the entire length of the tube and about 80 per cent of the periphery was corroded. Later inspections showed that the trouble was commencing in top row tubes. In all the corrosion products removed from these tubes iridescent particles were found, later confirmed by X-ray analysis to be metallic copper.

It is believed that here again the rate of attack was very rapid, as any deposit or tube deformation would have been observed during the thorough examinations to which these boilers are subjected, and for these reasons the duration of attack and subsequent failure is estimated to have been about six months.

The feedwater has a pH of 8.5 and electrical conductivity of approximately 2.4 reciprocal megohms per cm^3. Prior to the war the feedwater pH was consistently 7.3 and the electrical conductivity was 0.6 to 0.8 reciprocal megohms, the increase being attributable to increased ammonia content.

Boiler-water conditioning is carried out by individual injection to the boiler drum, the conditioning being essentially by sodium phosphates, with caustic soda used only infrequently. Sodium sulfate is added to give a sulfate/alkalinity ratio of 3, and sulfite is injected when a boiler is to be banked or taken off the range. There is no continuous feed injection or blowdown. The oxygen content of the feedwater determined regularly by the "dead stop and point" method shows the general content to be below 0.015 ml/liter and more often than not below 0.01 ml/liter. The phosphate content of the boiler water was maintained around 7 ppm and the alkalinity above pH 8 around 35 ppm, giving a boiler water pH of approximately 10.5.

Chloride content of the boiler waters at both these stations is usually low and never allowed to exceed 50 ppm. Ammonia content varies according to the season, a general figure for the winter months being 0.2 to 0.25 ppm and 0.1 to 0.15 ppm for the summer; higher winter ammonia contents in the raw water have been experienced.

There are several similarities between these types of corrosion which have occurred at these stations:

1. The corrosion product in the immediate vicinity of a deep pit is hard and laminated.
2. The corrosion product is almost entirely magnetic oxide Fe_3O_4.
3. Metallic copper has been found between the laminations of the corrosion product.
4. Finely divided copper as metallic particles is present.
5. Some loose corrosion product is always present as a fine powder. This is less noticeable at Deptford than at Battersea, probably due to the former tubes being vertical.

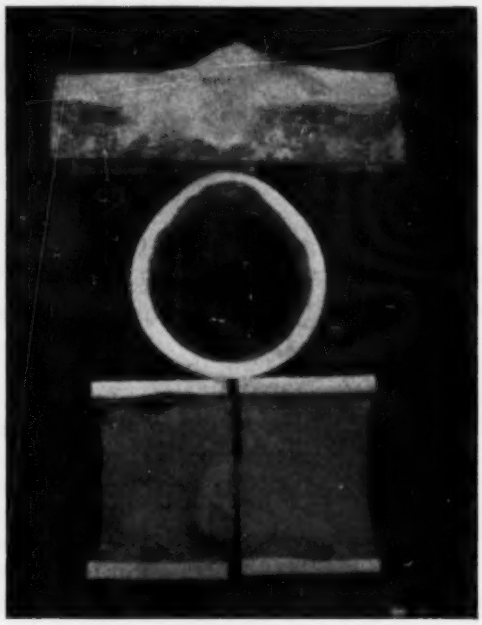


Fig. 2—Tube from boiler No. 7 at Battersea showing corroded bottom half and deformation.

The main differences are:

1. Corrosion is localized at Deptford and occurs where residual stresses are highest.
2. The corrosion product at Deptford is more firmly attached to the tube than that at Battersea; the area of attachment is smaller than the deposit itself but the deposit has frequently to be hammered to achieve removal.

It was found that a large number of stations in Great Britain were suffering from this type of corrosion, but it was difficult to find any theory which would entirely satisfy the existing conditions. In fact, one had only to consider boilers in the same station subjected to the same operating conditions where boilers of one design might be affected while those of another type appeared to be immune.

In each case of this type of corrosion that came to our knowledge, the following two significant features stood out:

1. Considerable quantities of copper were present in the corrosion products.
2. The ammonia content of the water used for preparing makeup had increased over the past years.

Owing to the possibility of enemy air attack damaging water supply lines, chlorination of the city water was increased. This necessitated slightly increased ammonia concentration to maintain potability, but the more important result was that the nitrogen oxidizing bacteria in the water were killed, so that the ammonia remained as chloramine and was not converted into the innocuous nitrate.

Metallurgical examination of the metal gave no indication of embrittlement. The only fact which examination showed was that spheroidization of the pearlite had occurred owing to the high temperature prevailing at the seat and in the vicinity of corrosion. This led to the belief that the copper-iron electrolytic cell was playing some part, and laboratory experiments were conducted which showed that appreciable amounts of copper could be deposited on iron from boiler-water samples. The following theory was therefore advanced as a working basis.

Theory Advanced

The high rate of heat transfer induces high rates of ebullition with rapid concentration of dissolved salts which will be left in the film adjacent to the metal; and it is conceivable that at the temperatures prevailing decomposition of some of the salts may take place before the alkaline boiler water floods back, with consequent reduction in reserve alkalinity. Also if double decomposition between soluble solids occurs to give rise to insoluble phosphates, the alkalinity may be locally depressed still further, thus giving temporarily a low pH and enabling various cells to function at a very increased rate. An emf of 600 millivolts at pH 6.5 has been ascribed to the copper-iron cell.

At Deptford and Battersea the alkalinity of the boiler water has been increased to a minimum of 50 ppm $CaCO_3$ at pH 8, and the phosphate concentration was simultaneously increased to approximately 20 ppm in order to increase the buffer capacity in the films. Since 1945 the rate of corrosion has been greatly reduced; in fact, at Deptford it has virtually stopped. No further failures have occurred, although some evidence of corrosion of this type has been experienced at Battersea, on a considerably reduced scale. It is significant that copper is still found in the boiler sludges and the metallic copper content often reaches 40 per cent of the sludge. There has been no sign of this type of corrosion in the extra high-pressure boilers, but balls of hard iron oxide—chiefly magnetite—encased in a skin of metallic copper have been found. These balls have been up to $^1/_2$ in. in diameter.

General Inferences

If the answer to this problem lies in increasing alkalinity then it surely shows that some condition or conditions have changed to result in this virulent type of corrosion. Thorough examination of boiler operating conditions have indicated that:

1. Boiler-water conditioning at Battersea was satisfactory prior to 1945. The tube failure in June of that year was the first indication of internal corrosion of any magnitude. It will be remembered that the Deptford boilers had operated for seven years without conditioning and without appreciable corrosion.

2. The increase in ammonia content of the raw city water brought about by the exigencies of war and enemy air attacks had a profound bearing on the copper content of the feedwater and consequently the boiler water.

3. Boiler design may have some bearing upon this type of corrosion, but in view of (1) above and the high head to which the most affected tubes are subjected in the case of the Battersea boilers, it is difficult to see how this factor functions except for heat-transfer considerations.

4. One is forced to the conclusion that treatment which is satisfactory under normal conditions is not so when copper is present in the boiler, and that alkali reserves must be increased.

The remedies adopted and apparently effective have been outlined. Long-term remedial measures involve the partial or complete removal of ammonia from the feedwater by deaeration of raw mains zeolite base-exchange softened water before evaporation and the treatment of ejector drains for ammonia removal. Laboratory investigations have shown that if the chlorine can be removed by some chemical reducing agent, such as sodium sulfite or thiosulfate, or adsorbed by active charcoal, and the dechlorinated water passed to a sandbed inoculated with nitrogen oxidizing bacteria, about 90 per cent of the ammonia is removed from the water, leaving a concentration of approximately 0.01 ppm of ammonia in the water fed to the evaporators.

If the ammonia content of boiler feedwater can be substantially reduced, not only will the factors considered responsible, at least in part, for boiler corrosion be reduced, but some increased protection will be afforded the copper alloys in the remainder of the plant.

A.I.E.E. WINTER MEETING

Papers discussing heat balance in industrial power plants, design and operation of central stations to compensate for fluctuating loads, gas turbines for power generation and vaporization cooling of electrical machines were included in the program. The discussions were by speakers representing both equipment manufacturers and operating companies.

SEVERAL items of interest to engineers in the steam power field were included in the program of the Winter General Meeting of the American Institute of Electrical Engineers held in New York City from January 31 to February 4.

J. B. Glasby, power and test engineer of The Atlantic Refining Company, presented a paper entitled "By-product Power via Topping Turbines" in which he described improvements made since 1940 in the power and steam generating facilities at the Philadelphia refinery of his company.

Studies were made of the existing facilities and it was decided to install new steam generating units and to undertake partial generation of electric power by means of back-pressure turbine-generators which topped the steam system then in use. In this manner reserve generating capacity was not solely dependent upon plant spare equipment, and two independent sources of power were made available in case of emergency. Steam conditions were limited to 650 psi and 750 F because it was felt that the 85 per cent average required makeup would cause feedwater conditioning to be unjustifiably expensive were higher steam temperatures and pressures to be employed.

Some consideration was given to the possibility of purchasing all process steam and electrical power from a projected plant to be constructed and operated by the local public utility. However, studies indicated that the topping units then under consideration for the refinery could compete favorably on an economic basis with any comparable sized facilities operated by a public utility.

At present the refinery generates approximately 40 per cent of its 60-cycle power requirements at a cost of 4 mills per kwhr, including operating labor, maintenance expenses, overhead, depreciation and steam costs. The last-mentioned are determined from the product of the total boiler house operating cost and the ratio of the Btu required to generate power to the total Btu input.

"Steam and Electrical Balance in Chemical Plants" was the topic of a paper by **L. W. Roush** of the South Charlestown, W. Va., plant of Carbide and Carbon Chemicals Corp. General considerations of heat balances for industrial plants were mentioned, and alternatives for designers of such plants were pointed out. Necessity of continuity of services for chemical plants was emphasized, together with problems arising from surges originating on exposed transmission lines of utility systems.

Referring to steam conditions for by-product generating plants, the speaker indicated that the primary steam pressure is dependent on the economics of the chemical treatment of feedwater and amount of makeup, the latter being quite large in most chemical plants. In general, he contended, the minimum economical limit for steam pressure in a by-product plant is 400 psig. For a new power station present practice in chemical plants would indicate steam conditions on the order of 900 psig and 800 F.

G. H. McDaniel of the American Gas and Electric Service Corp. presented a paper on "An Operating View of the Problem of Fluctuating Loads on Steam Plants." After dealing with the historical background of power system interconnection, he indicated some of the problems of frequency control and their relation to system inertia and responsiveness to change of turbine governors and steam generating units.

A small load change in per cent of total system load may become a large percentage of unit or station capacity when system regulation requirements are assigned to that unit or station. The cost of providing boiler equipment capable of handling rapid load changes required by such a regulating unit has not appeared to justify itself when the regulating duty can be reduced by dividing load changes among several power stations or units. In this manner regulating ability comes within the feasible operating range of standard equipment.

Unit Plant Operation

With the trend toward the unit boiler and turbine plant, the same individual may be responsible for operating both and therefore can coordinate operation better than under the former plan of divided authority between the boiler and turbine rooms. This is important because present high-pressure, high-temperature boilers have little water storage capacity and therefore have rapid drops in steam pressure with marked increases in steam flow. The length of time in boiler-pressure response varies directly with the amount of storage capacity found in the boiler. To account for rapid increases in load, it is necessary that boiler equipment start overfiring as soon as possible in order to prevent carryover, and to do this indication of system unbalance must be transmitted beyond the turbine governors to the combustion control system. In this manner changes in steam pressure may be anticipated by six to ten seconds and overfiring begun, in order to prepare for the load change.

Adequate and reliable control throughout the system and on interconnections is necessary to minimize load fluctuations without putting excessive burdens on generating equipment and transmission lines. To do this requires the coordination of governing systems, turbine control valves, and steam generating combustion control equipment with automatic frequency and tie line control.

P. S. Dickey of Bailey Meter Co. and **P. R. Loughlin** of Babcock & Wilcox Co. presented a paper on "Design of Boilers and Control for Fluctuating Loads." Operating conditions and methods of control for steam generating units for both central stations and marine use were discussed with particular reference to responsiveness to variable conditions.

It was emphasized that the high-temperature, high-pressure, base-load steam generating units of today must be capable of taking the system swings of tomorrow. Some factors which govern pickup time for central station units include the following: accumulator action of water within the boiler, temperature rise in metal parts, time required to accelerate steam release, practical limits of overfiring, permissible steam pressure drop, and effects of reduced electrical system frequency.

Essentially, automatic control equipment for rapidly fluctuating loads is similar to that used in the usual installation, though the operating demands may be far more severe. In designing for rapidly varying loads it is of utmost importance to have complete cooperation and coordination between the boiler designer and control designer in order to obtain most satisfactory results for practical and safe operation. There are many instances in which the turbine designer can also participate to aid in securing the best balance between turbine and steam generating units and their control, thereby helping to adjust both to meet extreme system fluctuations.

Robert L. Reynolds of Westinghouse Electric Corp. delivered a paper on the "Effect of Fluctuating Load on Steam Turbines." He recommended that load changes be made as slowly as practicable, preferably at a rate not exceeding 2 per cent of rated load per minute, and that initial steam temperature be changed gradually, ideally at a rate not exceeding 2 deg F per minute.

The most serious result of large and sudden load changes on the turbine is the change in the steam temperature in the high-pressure section of the turbine. This temperature is affected not only by the inherent changes due to change in stage pressure but also by the fact that the initial steam temperature is reduced at smaller steam flows. However, if boilers are designed so that full steam temperature is maintained down to a small flow, temperature changes within the turbine are reduced.

Sudden changes in initial steam temperature affect the turbine in two ways:

1. Changes in axial clearance because of differential expansion between stationary and rotating parts.

2. Changes in radial and axial clearances due to thermal distortion of the high-pressure casing.

Means must be found for overcoming such problems as the newer and larger power stations are required to provide their share of system frequency control. Although more efficient and operating under more severe steam conditions, turbines now being built can withstand load fluctuations with greater safety than can older turbines formerly used for this service.

E. E. Parker and **C. W. Elston** of General Electric Co. presented a paper asking, "Are Modern High-Pressure, High-Temperature Turbines Suitable for System Speed or Load Control Service?"

The rate of steam temperature change within the turbine is an important factor to be considered in evaluating the effect of varying load on a turbine. In machines governed by multiple valves, reduction in steam temperature through the first stage varies considerably with loading. With constant throttle temperature, there may be a 75-deg F change in steam temperature through the first stage, corresponding to a 25 per cent of rating load change.

The type of loading to which a turbine is subjected, if the magnitude and rate of load changes exceed certain values, affects the level of efficiency at which the unit can be maintained as well as the amount of maintenance which will be required.

When a turbine is running at light load, it can be safely loaded as rapidly as dry steam can be supplied when system conditions demand it. Likewise, the total load can be dropped instantaneously from a unit. As far as the turbine is concerned, the best way to unload it is to shut the steam flow off instantly, but such a procedure is rarely followed because of the effect on the system and other apparatus. Rapidly fluctuating cyclic loads on a turbine are, in general, not as severe as the same load change at a somewhat slower rate since, if the load is rapidly fluctuating, the turbine parts do not follow the steam temperature changes but rather remain essentially at an average value.

Gas Turbines

In his paper entitled "Gas Turbines in Stationary Power Generation" **F. T. Hague** of Westinghouse Electric Corp. presented a general survey of the gas turbine field. As a high-speed aircraft power plant the gas turbine is well established because it can compete favorably with other types of power in terms of initial cost, size, cost of power generation, life, maintenance and reliability. In the stationary power field it appears that the gas turbine will initially supplement the steam plant for peak load service.

The southern oil and gas fields in this country appear to afford opportunities for the gas turbine because of the combination of low fuel cost and large industrial electrical power consumption. Abroad in sections where there is no cheap fuel, gas turbine development has been guided by achievement of low heat consumption per unit of generated power, and particularly in England and France the work in this field has been largely government subsidized.

Further development of more efficient gas turbine units is largely tied up with material development and construction problems to utilize temperatures 300 to 500 deg F higher than the present 1250 F level.

"Two Gas Turbines for Power Generation and Other Applications" was the title of a paper delivered by **Alan Howard** of General Electric Co. The 4800-hp unit built by that company was described, and it was indicated that major application of similar simple type plants of moderate overall efficiency may be expected where fuel is inexpensive, the utilization of waste heat is desirable, or small size and light weight are important. Cooling water is required only for lubricating oil, and air-cooled radiators may be substituted in areas where water is difficult to obtain. Lightness and compactness make possible the use of simple and inexpensive housing and foundations.

A gas turbine for a 5000-kw generating set has been designed for a higher efficiency than the unit just described. This improvement is obtained by using intercoolers between compression stages and regenerators for preheating air entering the combustion chambers by utilizing turbine exhaust heat. The anticipated thermal efficiency of 28 per cent is better than that of steam stations of comparable size. Such turbines may prove attractive for end of line installations and for stand-by and peak load operation in which quick starting is of particular advantage.

"A 3000-Horsepower Gas Turbine Power Plant" was the topic presented by **J. S. Haverstick** of the De Laval Steam Turbine Company. The unit described employs a mixed-flow type compressor and is so constructed that the power shaft is mechanically independent of the rotor of the compressor and compressor driving turbine. This arrangement has the advantage of allowing the load to remain at constant speed while the compressor and its turbine are brought to their most desirable speed. The maximum diameter of the casing is 68 in. and the length from power output coupling to starting motor coupling is 22 ft 8 in.

To allow flexibility in the operation of the plant a bypass is placed around the power output turbine. It is economical to use the bypass only during idling operation, but its presence enables the plant to be used in applications where the simpler single turbine plant is unsuited. Regulation of the unit is achieved by speed control from the power turbine to the fuel supply with a maximum temperature limiting device as a safeguard for the high-pressure turbine.

Vaporization Cooling

A new method of cooling large electrical machines was reported by **Th. de Koning** of Drexel Hill, Pa., in a paper on "Vaporization Cooling of Large Electric Machines." Employing principles totally different from those customarily associated with air, hydrogen and fluid cooling, vaporization cooling is a means for cooling large machines of all types by supplying water in mist form to natural surfaces bordering the air gap. The gap and the space surrounding the end surface are kept under vacuum.

Designs embodying vaporization cooling involve practically one solid block of material, are fully self-contained, do not require openings in the foundation, are compacted by the external pressure, and are because of the vacuum as noiseless as hydrogen-cooled machines. The proposed vaporization cooling system is expected to have the following advantages over the present cooling systems:

1. A saving of 5 to 15 per cent in copper and punching volume.
2. A slightly better efficiency, improved simplicity, a saving of 25 per cent in weight and 15 per cent in cost of large machines.
3. Less space than required for hydrogen-cooled units.
4. Fewer operating complications than for hydrogen-cooled units.
5. Suitability for any size and environment and for constant or variable speed.
6. Auxiliary equipment of low cost and conventional design.

New Specifications for Stainless Steel Pipe

The A.S.T.M. Administrative Committee on Standards has approved new specifications for austenitic stainless steel pipe which had been under development for many months. They cover five grades of material involving both seamless and welded pipe that is intended for high temperature and generally corrosive service. These five grades are chromium-nickel-titanium, chromium-nickel-columbium, chromium-nickel-molybdenum (TP 316) and chromium-nickel-molybdenum (TP 317). Maximum carbon runs 0.08 per cent, manganese 2 per cent, phosphorus and sulfur 0.03, and maximum silicon 0.75 per cent. Nickel ranges from 8 to 14 per cent with the chromium content from 16 to 20 per cent. Minimum tensile strength is 75,000 psi and the yield point 30,000 psi. Longitudinal elongation in 2 in. is 35 per cent and transverse elongation 25 per cent.

The Fourth World Power Conference

Plans are beginning to take shape for the Fourth World Power Conference which is scheduled to be held in London, July 10 to 15, 1950, with headquarters at the Institution of Civil Engineers. The general theme will be "World Energy Resources and the Production of Power," with the technical program divided into three sections, namely, energy sources and power developments, the preparation of fuels, and the production of power. There will also be a number of study tours.

It will be recalled that the first Conference was held in London in 1924, the second in Berlin, in 1930, and the third in Washington, in 1936. The war intervened to upset the schedule for the fourth general meeting.

The chairman of the Conference will be Sir Harold Hartley; the general secretary, C. H. Gray; and the chairman of the program committee is Harold Hobson, formerly chairman of the British Electricity Board. Other announcements will be forthcoming as the plans and program develop.

New York City Adopts Smoke Control Bill

On February 1, 1949, the City Council of New York passed the Sharkey Bill for control of smoke and soot. Responsibility for smoke control, which is now divided among five agencies including the Board of Standards and Appeals, the Department of Housing and Building, the Board of Health, the Health Department and the Fire Department, will be centralized in a Bureau of Smoke Control which is assigned to the Department of Housing and Building.

Recent efforts to minimize air pollution in New York City have been initiated by the Citizens Union through its Committee on Air Pollution, of which Arthur C. Stern is chairman. A report was prepared to indicate some of the harmful effects of air pollution and to review steps which other cities had taken toward solving this problem. By comparison of these efforts with existing regulations in New York City, it was possible to bring to public attention the need of an integrated plan of control to replace archaic and unenforced regulations.

The Sharkey Bill is a smoke control bill rather than a general air pollution bill. However, since smoke and allied nuisances covered in the bill comprise 90 per cent of all air pollution, the Sharkey Bill does amount to a significant advance, particularly because of its unification of control and responsibilities in one bureau.

The bill includes a declaration of policy in which injurious effects of atmospheric pollution by smoke, soot, fly ash and products of combustion are set forth and the right of the city to supervise combustion processes and emissions into the atmosphere is established. To implement this policy a smoke control board consisting of five members is established. Three of the members are to be appointed by the mayor and include a licensed professional engineer experienced in smoke control, a mechanical engineer who is also a professional engineer, and a stationary engineer. The other two members are the commissioner of housing and buildings and the commissioner of health who serve on an ex-officio basis.

The director of the Bureau of Smoke Control, who will be one of the three appointed members, is responsible for the investigation of smoke and other emissions and for the enforcement of laws, rules and regulations with respect to such emissions. Rules and regulations controlling smoke pollution are to be made by the smoke control board, which has the power to supersede conflicting rules and regulations of any other board or agency affecting matters within its jurisdiction except those of the Board of Health.

Persons contemplating future installation or major alteration of equipment capable of emitting products of combustion must file an application, including plans and specifications, with the Bureau of Smoke Control. The director has the right to issue installation permits or to dispense with the filing of applications when deemed unnecessary. Operation is not permitted to those granted installation permits until an operating permit has been issued by the director, who has the power

to seal any equipment operated without the required permit. Provision is made for appeal to the Board by any person who is adversely affected by decisions of the director.

Penalties for violating the provisions of the bill or the rules and regulations of the board are fines of not less than $25 nor more than $100 or by imprisonment for not more than three months, or both, for the first offense, and by a fine of not less than $50 nor more than $500 or by imprisonment for not more than six months, or both, for a second or subsequent offense. The law is to take effect on March 1 of this year.

Gas Turbine Applications

Use of portable gas-turbine plants mounted on railway cars and capable of producing between 3500 and 5000 kw for emergency power purposes was suggested recently by B. H. Hatch, turbine engineer of the General Electric Company. Units of that size could be mounted on two or three cars for mobility of operation.

Three more immediate applications of the gas turbine were also noted by Mr. Hatch as an economical base load plant for small and medium size power systems, as an "end-of-line plant" to stabilize voltage with fluctuating loads and help the major system meet peak load demands and as stand-by plant to meet peak load demands.

The heat rate of 5000-kw gas turbine design now being manufactured by General Electric is on the order of 12,500 Btu per kwhr. Present machines burn natural gas or heavy fuel oil, but future designs contemplate the use of pulverized coal, coal-produced gas or blast-furnace gas.

A.S.M.E. Spring Meeting

Tentative plans have been announced for the 1949 Spring Meeting of the American Society of Mechanical Engineers. This will be held May 2–4, at New London, Conn., with headquarters at the Mohican Hotel. Several of the Connecticut sections of the Society will cooperate as hosts. The three-day program will include sessions on fuels, gas turbines, power, industrial instruments, management, process industries, machine design and safety. Several plant trips are being arranged including a visit to the U. S. Submarine Base, the U. S. Coast Guard Academy and the plant of the Electric Boat Company.

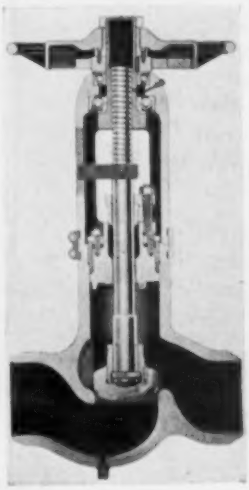
Research in Coal-Waste Fires

A research fellowship program, established by the Western Pennsylvania Coal Operators Association, was undertaken in January at the Mellon Institute to study the causes, prevention and control of coal-refuse fires. It is planned to investigate the reactions of coal and inorganic sulfides, especially at low temperatures, as well as all factors entering into the problem of the spontaneous combustion of coal waste, particularly when piled.

NEW EQUIPMENT

Cast Steel Valves

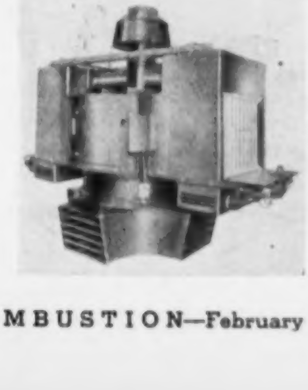
The research laboratory of Edward Valves, Inc., East Chicago, Ind., has developed a new design for cast-steel valves which makes possible the installation of a size smaller valve in pipe lines. Pressure loss in the new body design is decreased by streamlined internal contours which eliminate wear-producing turbulence, by



reduction of weight in all floating parts, and by equalization of pressures in all internal areas of the valve. In some sizes the new design reduces the weight of valves to less than 50 per cent of the weight of old designs. Stop and non-return valves in either the globe or angle design are available for all sizes 6 in. and above in 900, 1500 and 2500 lb ASA classes.

Gas-Fired Unit Heater

A new, self-contained gas-fired revolving unit heater has been announced by the L. J. Wing Mfg. Co., New York, N. Y. Using either natural or manufactured gas, the heater combines gas burners, heat exchanger and combustion chamber with a motor-driven Wing-foil fan and revolving discharge outlets. By employing the heater in an overhead location, heated air may be projected to the working level and circulated in all directions. The gas-fired revolving unit heater is approved by the American Gas Association.

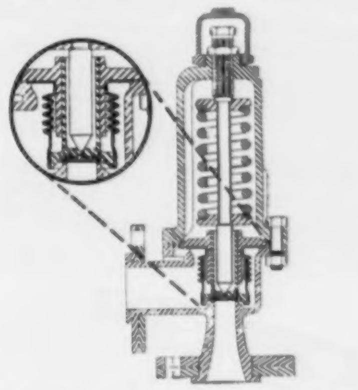


Refractory Coating

The Ceramic Research Department of the New York College of Ceramics, in conjunction with the Robert G. Allen Co., Mechanicville, N. Y., has developed ALLENCOTE Chrome ore refractory coating for fireclay brick and moldables. The material has a temperature range of 2400 F to 2850 F. When the furnace wall is laid up with this product as a joint binder and then coated with the material, the wall becomes a membrane sealed against air infiltration.

Safety Valves

The Farris Engineering Corp. of Palisades Park, N. J., has announced the Farri-Seal Bellows as a new type of safety valve construction that completely isolates the lading fluid from the valve spring chamber and guide surfaces. The bellows acts as a



flexible joint which seals the spring, guides and adjusting screws from the vapor or fluid in the body of the valve, thus preventing fouling of the guide and minimizing corrosion. Construction of the bellows is such as to allow the safety valve its full stroke plus over travel without reaching the stress limits of the bellows themselves.

Thermal-Conductivity Gas Analyzer

The Bailey Meter Co., Ivanhoe Road, Cleveland, O., has expanded its line of gas analyzers to include a thermal-conductivity type gas analyzer. The analyzer operates on the principle of thermal-conductivity gas analysis which measures the rate at which heat is conducted by the gas being sampled. Mounted in an explosion-proof case and thereby unaffected by voltage variations, ambient temperatures and variations in sample pressure, the new unit employs an a-c circuit and a standard electronic recorder which results in unusual stability, fast response, and minimum maintenance attention. Two records of thermal conductivity can be placed on the same 12-in. diameter chart, or one record may be combined with another of flow, pressure, temperature or some other related factor.

Personals

J. P. Bufe has been appointed head of the power division of the Monsanto, Illinois, plant of the Monsanto Chemical Company. He has been with that Company since 1936.

Neil J. Braski has been selected as assistant superintendent of power at the Painesville, Ohio, plant of Diamond Alkali Company.

Dr. Ernest F. Fiock has been appointed chief of the newly organized combustion section of the National Bureau of Standards. In this work he will be responsible for the application of combustion research in the fields of gas turbines and jet engines.

M. A. King recently rejoined the Elliott Company as engineering vice president of the Jeannette Division.

Harald M. Olson, general chairman of the Industrial Water Conference held annually in Pittsburgh since 1940, has been named consulting maintenance engineer for Morton Salt Company, Chicago. He will also continue his activities with the water conference.

C. Richard Waller has been named vice president and director of engineering by the De Laval Stream Turbine Company, Trenton, N. J.

Edmund McCarthy, until recently with the Fairmont Coal Bureau, has been appointed consulting engineer for the Pittston Company with offices in the Empire State Building, New York.

E. S. Coldwell has been elected president of Ford, Bacon & Davis, Inc., well-known New York engineering firm. He succeeds J. F. Towers who becomes chairman of the board.

George A. Porter has been made chief engineer of power plants of The Detroit Edison Company and **Henry E. Macomber** has been appointed assistant chief of power plants.

J. C. Crownover, formerly with Rust Engineering Co., Pittsburgh, has been appointed results engineer with the Long Island Lighting Co. at its Port Jefferson Station.

James F. Fairman, Vice president of the Consolidated Edison Company of New York, has been nominated for the presidency of the American Institute of Electrical Engineers.

W. F. Dueringer has been made supervisor of service engineering of Allis-Chalmers. He has been with that company since 1929.

Business Notes

The **Wm. Powell Co.** has appointed Joe L. Comer vice president in charge of sales in the New York area, with offices at 50 Church St., New York City.

Bernard H. McGuiness has been appointed vice president of the Robins Conveyors Division (Passaic) of **Hewitt-Robins, Inc.**

Combustion Engineering-Superheater, Inc. has advanced Paul Waller from contract salesman, Chicago, to district manager, Minneapolis.

Calgon, Inc., announces that John P. Kleber has been named manager of the Division of Municipal and Process Waters with George L. Illig, Jr., serving as his assistant.

Expansion of sales territory to include the entire states of Minnesota and North Dakota, western Wisconsin, northern Iowa and eastern South Dakota has been announced for the Minneapolis representative of **The Dampney Co. of America,** Ray Ekberg.

The following changes in sales and manufacturing division of the **Yarnall-Waring Co.** have been made: Joseph Kildare and Frank W. Miller have been elected vice presidents in charge of sales and manufacturing, respectively; Carl Liberg is now located at the new district office in Buffalo, and C. V. Peterson has been appointed sales representative in the Cleveland district.

Dearborn Chemical Co. has made the following assignments for members of their sales force: William J. Tobin has been appointed as representative in the Minnesota territory; Roy O. Benson, in the Chicago territory; and E. W. Houseknecht, in the Wisconsin territory.

Harold A. Schlieder, formerly chief engineer of **Northern Equipment Co.,** has opened his own office as sales and service representative in Syracuse, N. Y. He has been succeeded by Francis W. Bunting, who is now responsible for all sales and service engineering. Harry H. Weining has been placed in charge of production engineering in addition to his duties as director of research.

Walter Rahel has been named advertising manager of the **De Laval Steam Turbine Co.,** Trenton, N. J.

Manning, Maxwell & Moore, Inc., has announced the appointment of Henry S. Moore as director of engineering and development for the Consolidated-Ashcroft-Hancock Divisions of the Company.

Mr. George H. Kent has been appointed director of sales for **E. F. Drew & Co., Inc.,** and will be in charge of coordinating sales activities for the operating divisions of the Drew Company.

NEW CATALOGS AND BULLETINS

Any of these may be secured by writing Combustion Publishing Company, 200 Madison Avenue, New York 16, N. Y.

Automatic Production Control

A new 16-page booklet has been released by the Reeves Pulley Co. describing automatic production control applications of variable-speed drives and related equipment. Some of these controls are employed on traveling grate and spreader stokers. The bulletin includes schematic diagrams and photographs of typical installations.

Automatic Shut-Off Valves

The Security Valve Co. has released a 4-page bulletin describing its line of automatic low-pressure shut-off valves, designed for use on gas or fluid lines. A table of weights and dimensions is included.

Motor Starters

Allis-Chalmers Mfg. Co. has published a 12-page bulletin describing its line of alternating-current full-voltage motor starters. Construction features and uses of manual and magnetic across-the-line starters, across-the-line combination starters, reversing starters and push-button stations are illustrated.

Oil and Gas Firing

The Coen Co. has recently brought out a series of six bulletins illustrating their products for oil and gas firing. These comprise Bulletin No. 27-A, dealing with Fuel and Lubricating Oil Heaters; Bulletin No. 28, "Safety" Duplex Strainer; Bulletin No. 30, Pump Sets; Bulletin No. 40-1, Fuel Firing Valves; Bulletin No. 48, Burners for Oil and Gas Firing; and Bulletin No. 90, Sleeve Valves. They include schematic diagrams and design data.

Steam Traps for Unit Heaters

Armstrong Machine Works has issued a useful 8-page bulletin explaining how to select steam traps for unit heaters by the Btu rating and condensate methods. Included among the data are listings of Btu outputs under standard conditions of various sizes of unit heaters produced by 24 manufacturers, as well as appropriate conversion tables, installation diagrams and recommended trap sizes.

Heating Steam Economy

Builders-Providence, Inc., has reprinted from "*Heating, Piping & Air Conditioning*" two articles by William B. Pride of the Boeing Airplane Co. entitled "Here's How to Save Heating Steam." Methods of simplifying and assuring fuel economy are explained, and charts showing daily operating experience are reproduced. The 12-page booklet will be of interest to those concerned with problems of heating in large buildings and industrial plants.

Galvanic Cell Corrosion

International Nickel Co. has made available an 8-page reprint from the Inco Corrosion Reporter entitled "Corrosion by Concentration Cells." Unusually well written, the article explains fundamental principles of corrosion in terms of readily understood analogies. Also appended are rules for minimizing or preventing concentration cell corrosion. Engineers should find this release a valuable educational source of basic information on corrosion roblems.

Hydraulic Valves

Tanner & Arnold has issued a 48-page bulletin describing and illustrating "Atwood" valves manufactured from the original patterns, drawings and gages used by the Pittsburgh Valve, Foundry & Construction Co. These valves are designed for hydraulic systems up to 3000 psi; sectional views and dimensional tables of valves and fittings are included. The same company has also recently released a 4-page bulletin showing repairs and replacements for valves formerly produced by the Pittsburgh Valve, Foundry & Construction Co.

Forced Circulation Unit

Superheater Divison of Combustion Engineering-Superheater, Inc., 60 E. 42nd St., New York, has brought out a catalog describing, by means of colored drawings, a new completely self-contained and efficient oil-fired forced-circulation steam generating unit with full automatic control for moderate pressures and capacities up to 3000 lb of steam per hour. A unit of this output occupies a floor space of approximately 5 x 6 ft and is 8 ft 4½ in. high. Designed primarily to supply steam for heating passenger trains operated with diesel-electric or electric locomotives, it could otherwise be employed where there may be special need for a package unit of this size and type.

Advertisers in This Issue